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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 mm

1 2 3 4 5

Inches

Thomas A. Edison Papers

A SELECTIVE MICROFILM EDITION

PART II
(1879–1886)

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at
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39

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THOMAS A. EDISON PAPERS

A SELECTIVE MICROFILM EDITION
PART II
(1879-1886)

REEL 39

NOTEBOOK SERIES (NBK-17)

Menlo Park Notebooks, #149 - #184

Menlo Park Notebook #149 [N-80-10-15.2]

This notebook covers the period October 1880. It is a continuation of Menlo Park Notebook #148. The entries are by Edison, Francis Upton, and Francis Jehl. The book contains notes and drawings by Edison regarding tests made of lamps 70-98 from Lot 2. Included also are statistical results by Upton and Jehl along with summaries by Edison and Upton of results from all the lamps in Lot 2. The label on the front cover is marked "Lamps No 2," "No 70-98," "Oct 1880," and "F Jehl." The book contains 284 numbered pages.

Blank pages not filmed: 144-181, 192-257, 260-275, 278-283.

Index.

Elect 208 — 210 136 Volts.

R $\frac{31400}{200}$ 157 Ohms
+ 20
C 48. 5220

172 — 172

Elect

R $\frac{31400 + 1200}{200}$

C 16

76 nospots

No blue melanops

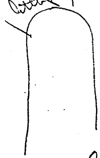
440
146

314
44
358
179

1644
1644
6464
7471
7223

Emf	220 – 220 146 Volts
R	$\frac{31400+4400}{2000}$ = 179 ohms
C	48 + 9 5270
E	185 – 185
R	31400 +
	$\frac{31400+640000}{2000}$
C	1/6

71.



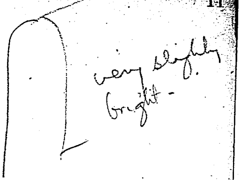
no blue on clamps
Arc sprung Res burned
plat burned off at
tip Carbon intact,

1523
1523
6464
8297

7807

Emf	212 – 214	142 Volts
R	$\frac{25150 + 4400}{200}$	148 ohms
		+ 11
C	48	6040
Emf	179 – 179	
R	$\frac{25150 + 5700}{200}$	
C	16	

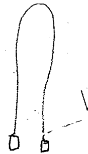
72 -



lts not
cracked

No blue on clamps

globe blackened badly



Res ok - no arc

1673
1673
6464
7399

7209

73

Em f	220–222	147 Volts
R	$\frac{31400+4900}{200}$	182 ohms
C	48	+ 7 ✓ 5260
Em f	189–190	
R	$\frac{31400+6600}{200}$	
C	16	

73-

Blue on Clamps

Arc sprung
Resistance Coil
Burned

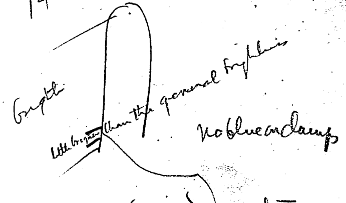
Lit not cracked

1673
1673
6464
7570
7380

74

E. M. F	220 — 220 147 Volts
R	$\frac{31400 + 3600}{2000}$ 175 ohms
C	44 $\frac{1}{5470}$ 7√
	Blue in globe
E. M. F	180 — 180
R	$\frac{31400 + 5400}{2000}$
C	16

14



Arc sprung burned resistance
but Carbon intact 7 ohm Res
Coil in Main puts in a 13
ohm Coil - to see what result
it is very blue in globe - no blue
on clamp - Howell says -
globe very black - Lamp goes ok -
I notice black on clamp towards
Position - arc sprung again but
Carbon ok we put in another
Res Coil - Busted here arc sprung
Res burned

1206
1206
6464
8153

7029

5040

75

E.M.F	198 – 198	132 Volts
R	$\frac{25150 + 5500}{200}$	153 ohms
C	48	+ 24 ✓
E.M.F	170 – 170	
R	$\frac{25150 + 7150}{200}$	
C	16	

75 =

little Unequal

Blue on clamps

bad in clamp - probably
honeycombed negative side ~~used~~ it
first arc'd & [illegible]
offRes then went for
4 or 5 mins & then
arcd again & busted
short at clamp

1703
1703
6464
7447
7317

76

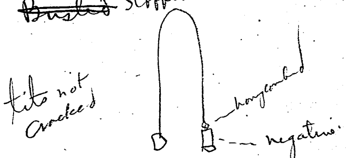
E.M.F.	222-222	148 Volts
R	$\frac{31400 \$45-00}{200}$	180 Ohms
		+ 6
C	4 r	5390
E.M.F	190-194	
R	$\frac{31400 + 4500}{200}$	
C	16	

76

little unequal -

It burned the silk off of its resistance but otherwise OK.

~~Bustd~~ Stopped



Res Cord burned - and fluffy stuff in globe -

Blue on clamps

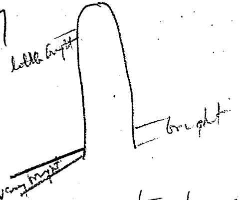
Put R on again & its burning low

1461
1461
6464
7966

7372

E.M.F	211 - 209 140 Volts
R	$\frac{31400 + 450}{}$ 15.9 ohms
C	46 +201
	5450
	180 - 180
	$\frac{31400 + 2100}{2000}$
C	16

77



twas honeycombed badly
pitch gone between sac fibres

Arc sprung Res Coil burned - it was not blue but it had a <u>split</u> in <u>clamp</u> = negative side. Carbon intact, platina leading wire burned at end of tit

Not blue on clamp

7644
1644
6464
7670
———
7422

78

E.M.F. 219-220 146 Volts

R $\frac{31400+2800}{200}$ = 200 171 ohms

C 48

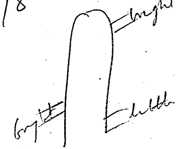
5530 + 81

E.M.F. 185-188

R. $\frac{31400+4500}{200}$

C. 16

78



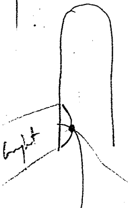
Very blue in globe I notice that
it nearly touches side of
globe = busted 5 mins
after - Resistance burned
arc spring - both
platina leading wires
burned off at tits = Carbon
intact = Howell says no blue
at clamps = blackening must
be nearly all if not
all platina

15.2.3
15.23
64 64
70 95
7105

79

E.M.F	212 - 215 142 Volts
R	$\frac{31400 + 3450}{200}$ 174 ohms
C	+ 13
	48 5730
E.M.F	182 - 183
R	$\frac{31400 + 5200}{200}$
C	16

79



Shopslip says split in clamp

Little bright

piece dropped out

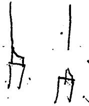
Lots Mercury in globe

Blue at clamp = arc

Spring Res Carb burned

(busted there) - must been

Split in clamp as its thin



piece dropped down

in negative side

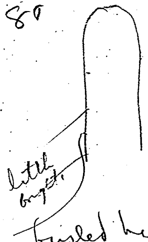
1399
1399
8464
7932
7194

80

E. M. F	209-205	138 Volts
R	$\frac{31400+600}{200}$	1.61 ohms
C		+ 17
	5240	

E. M. F	172-175
R	$\frac{31400+2700}{200}$
C	

80



No split in clamps

busted here, - but carbon at clamp badly honeycombed

Burned its Res Coil arc sprung clamp towards Posh got red hot =

Not blue at clamp

218
222
440
147

314
47
361
131

1673
1673
1673
6464
7423
7233

81

E.M.F. 218 - 222 147 Volts

R $\frac{31400 + 4700}{2000}$ = 181 ohms

C 48 + 71

5290

E.M.F. 185 - 185

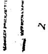
R $\frac{31400 + 6500}{2000}$

C 16

81

2nd Spots not blue at C
burned its Res coil of
7 ohms but lamp OK
Martin puts in 13 ohms
notices fuzzy lampblack
from carrying in glass
& on Carbon on side
towards Positive
Abated arcd = 9
Think it was bad
Contact in clamp on negative side arc
Spring
Clamp quite black towards Positive

W. Think was honeycombing



~~#~~ 1367
1367
6464
7825

7023

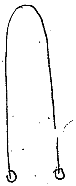
82

M.F	207 - 205	137 volts
R	$\frac{31400 + 1600}{200}$	165 ohms
		+ 191
C	48 5040	
E.M.F	170 - 172	
R	$\frac{31400 + 3400}{200}$	
C	16.	

82

Slightly Unequal

Not Blue at C



Inside black streak parallel with Carbon connecting to Positive on glass + white streak parallel to Negative

Res OK - No arc -

Tits not split

195
125
390
120

1139
1139
6464
8113
6855

E.M.F 195 – 195 130 Volts

R $\underline{31400 + 200}$ 158 ohms

+ 28

C 48 4850

E.M.F 168 – 168

R $\underline{31400 + 2000}$
~~200~~

C 16

83' - very slightly unequal

Not blue at Clamp

No Resin but acid & glass all busted

193
195
386
1.29

25150
5200
30350
156.7

1106
1106
6464
8041
6717

8/4

E.M.F. 193-195 - 129 Volts

R $\frac{25150 + 5200}{200}$ = 157 Ohms

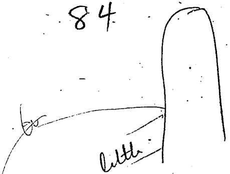
C 48 + 29
4700

E.M.F. 167-165

R $\frac{25150 + 7000}{200}$

C 16

84



Nat blue at clamp

Res burned

arc sprung
Brushed him Neg side

globe blackened

Neg clamp honeycombed

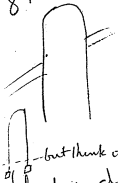
220
222
442
144

1673
1673
6464
7167
6976

85

M. F	220 – 222 147 Volts
R	31400 + 7000 192 ohms
C	48 + 8√
	4980
M. F	190 – 189
R	$\frac{31400 + 8700}{2}$
C	16

84



Little lots Mercury in globe -

Not blue at clamp

but think it broke mechanically

black on clamps towards Positive.

This Lamp burned its Reseclaina but seems to be O.K notwithstanding

Martin puts in a Res Coil of 6 ohm in place of 6 ohms. Arc sprung & burned off platinum wires at tit

Carbon OK - not blue in Clamps so says Howell

235
235
1570
156

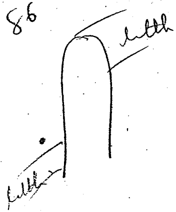
M. F.

R.

C.

48 Too high resistance

86



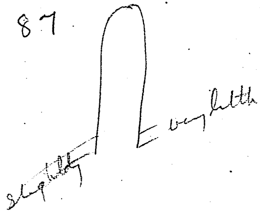
No Res Coil in this
lamp arc Sprung
Exploded inside glass
part broke all pieces
blue in clamp

1903
1903
6464
7471
7741

87

E. M. 7	235 – 230	13-5-Volts
R	$\frac{31400 + 4300}{200}$	179 ohms
C	48	
	5940	
M. 7	195 – 195	
R	$\frac{31400 + 6000}{200}$	
C	16	

87



Carbon intact - glass bursted
arc sprung - This lamp had no
resistance coil No blue in
clamps

~~Batt~~

1673
1673
6464
7520

7330

220 - 220 147 Volts

$\frac{31400 + 4000}{200}$ 177 ohms

48 5410 + 7

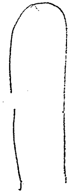
186 - 187

$\frac{31400 + 6000}{200}$

16

88 — no spots

Blue at clamps



not split in clamp

Res ok no arc

1139
1139
6464
8326

7068

89

M.F	195 – 195 130 Volts
R	25150 + 4100 / 2000 147 ohms
C	48 5090 + 26
M.F	166 – 166
R	25150 + 5900 / 2000
C	16

89 -

very very slight

Not blue at clamp

Honeycombed at clamp
negative side.

Res burned arc

Spring

not split clamp

1461
1461
6464
7496
6882

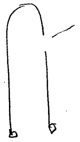
90

E.M.F.	210 - 210	140 Volts
R	$\frac{251.50 + 9500}{200}$	178 ohms
C	48	+ 17
	4880	
E.M.F.	180 - 182	
R	$\frac{31400 + 4800}{200}$	
C	16	

90 no spots

Not blue at Clamp

Restarted arc spray



1553
1553
6464
7773
7343

9.1

215 - 215 143 Volts

$\frac{31400 + 2000}{2000}$ 167 ohms

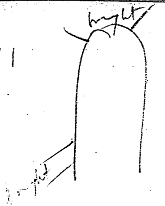
C 48 5420 × 12

186 - 187

$\frac{31400 + 3900}{2000}$

C 16

91

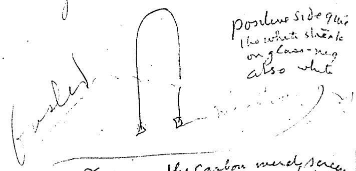


Not cracked in tits

Not blue at clamp

Res 8½ no arc

Globe blackened –



positive side quite
the white streak
on glass – neg
also white

I guess the carbon merely screens
the carbon vapor according to
which side busts nothing in it

92

~~2~~

~~$\frac{25 + 5}{}$~~

~~4~~

Too high resistance

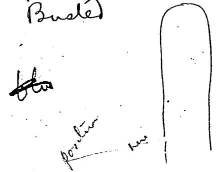
~~185~~

~~28~~

92 — very low
no spots

Spots getting bad on this —
after further time spots grow
fearful big must burst soon

Busted



Big blue in
Clamp towards
positive —

mercury in
globe

No Res Coil in this

Carrying towards Positive
its not cracked

1564
1584
6064
8182

7814

93

215 - 218 144 Votes

25150 + 5200 152 Ames

+101

48

6040

185 - 185

25150 + 6800

2100

16

93 Quite
Unequal

Glass busted — and Resistance
coil burned - Carbon intact.
no blue in 93 at clamps

TAE

~~2945~~	1673
~~2944~~	1673
~~6464~~	6464
~~7799~~	7799
153	7609

94

220 - 220   147 Volts

$\frac{31400 + 1700}{2}$ 166 dims

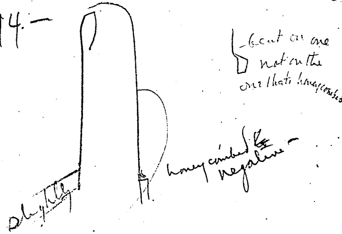
C 48   5760 ~~6170~~   + 71

185 - 184

$\frac{31400 + 3600}{200}$

16

94.—



Right here is a black spot due probably to a little piece of that ~~fuzzy~~ Carbon. a blue halo surrounds it
the opposite towards negative
Bushed = Res burned-arc
Sprung - plat wires burned off at bits Carbon intact
Blue ~~at clamp~~

1584
1584
6464
7773

5405

95

215-217 144 Volts

31400 + 2000 167 ohms

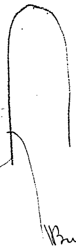
+10√

C 48 5500

185-187

31400-3500

95-



Slightly

Busted here.

Didnt burn Resistance

no blue in clamps no

black --

honeycombed at clamp

Its not Cracked

1399
1399
6464
7959

17221

96

E.M.F 208-205 138 Volts

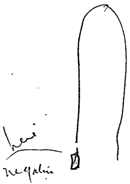
R $\frac{25150 - 6800}{200}$ 160 ohms

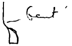
C 48 5270 + 171

180 - 180

$$\frac{25150 - 8200}{200}$$

96.— no spots





but not inside
Cohere breaks

Shop slip says
Clamps splice

Black on Clamps towards Pos
Howell says not blue —
Res off no arc

Globe blackened

~~[illegible]~~

lits not cracked

1761
1761
6464
7399

7385

97

225 - 225

150 Volts

31400 + 4900

182 ohms

2000

44

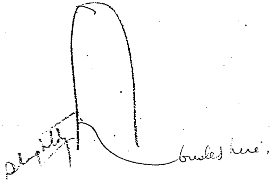
5480

189 - 188

31400 + 6900

200

97



Arc Sprung = only 1 turn on Res coil, burned Res Coil — both platina leading wires burned off at tits

Not blue at C

1.03.8
1038
6464
8539

~~8~~079

98

190 - 190

127 Volts

140 Ohms

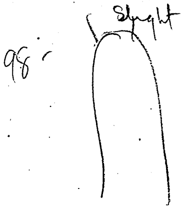
$\frac{25150 + 2900}{200}$ + 29

48

5100

169 - 169

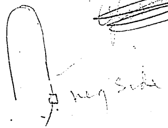
$\frac{25150 + 4000}{200}$



Not blue at C

Res burned arc
Sprung platina wire
burned off on positive tit

Carbon probably
busted mechanically



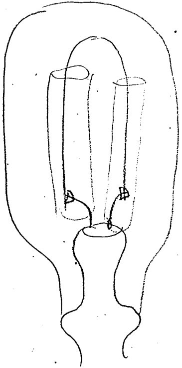
Note -

The first 3 lamps that bursted tonight ~~had~~ no resistance Coils = perhaps Resistance on all heated, increased their resistance hence the ones ~~that~~ had no res must have been higher =

The lamps tested tonight were a very nice lot, only 1 or two that are noticeably low + perhaps Res for these was wrong - Apparently there is no oxidation by leakage as I do not notice any noticeable increase in spots =

over

Must look out for cracks in
tits - after test over -



16 good
9 low
5 fair

6 – good
13 low
15 fair
18 low
22 low
29 good
36 little low
37 very good
40 little low
42 low
43 good
46 low
51 good
53 very good

55 extra good
57 good
62 good
67 fair
69 "
70 good
83 low
84 fair
90 fair
98 low

1 fair
2 fair
5 fair
6 good
8 fair
12 fair
13 little low
15 fair
16 fair
18 low
19 good
20 good
21 little low
22 low
23 – good
25 good
28 good
29 good

30 good
32 fair
33 good
34 good
35 fair
36 little low
37 very good
39 very good
40 little low
41 very good
42 low
43 good
46 low
50 good
51 good

53 - very good.
54 Extra good
57 good
62 good
63 good
64 fair
67 fair
69 fair good
70 good
71 good good
72
73 fair
75 fair
76
82 good
83 low
84 fair
88 good
89 fair
90 fair
91 good
98 low -

Lamps that became bright

Lot 2

37
43
51
53
57
69
98
40
42
53
57
69
84
98
37
40
42

43
51
53
57
67
69
83
84
87
98
18

29
22
13
36

Lot 1

40
47
91
1

Badly Spotted
no 84

These 4 came in order named

Blue at the clamps:

Lot 2

13
18
22
29
42
83
87

98 filled with very blue fluorescence.

Burst + burnt the resistance up

✓ 83 Burst – arc at clamps
no outside resistance in

13
18 Blue at clamps
22
29
42
67
87

Oct 15 – carbon not broken
✓ 36 Burst – arc below the clamp. Fused platina wire
Res O.K.

✓ 87 Burst, arc at clamps

✓ No 40 Broke - arc at clamps
resistance burnt off — negative
Oct 16. No 2 lot -

✓ Lot-1 Oct 16 Res OK"
No 1 - carbon broke at -
7.35 a.m Oct 16 1880 negative

✓ No. ~~90~~ 68 Lot-1 Oct 16 at 8.10 a.m
Res OK"
Carbon broken here.

No 67 lot - 2 Oct 16 positive
✓ 8.13 A.m
arc, Clamp fused,
resistance burned 890 / 13 / 903

✓ No 29 lot 2 Oct 16. 8.22 A.m 890 / 22 / 912 negative
Res O.K. broken here

No 37 — Lot 2 — 829 A.M.

Oct 16.

890
29
919

No 42 — 8,35 A.M. Oct 16

Lot 2

890
35
925

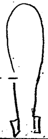
Oct 16

No 43 — 9.50 A.M.

Lot 2

890
50
940

carbon broken



Res O.K.

✓ 53 Lot-2.

Carbon broken

--- negative.

Res. O.K.

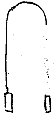
9.20 A.M Oct-16

950
20
970

✓ No 22 Lot-2 1070 60 1130 Oct 16.

Carbon broke at 11.40 A.M

Res. O.K.



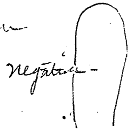
--- negative this was very badly spotted blue at clamp & a few minutes before it went Mr Edison revised it.

No 69 Lot 2

1130
52
1182

11.52 a m. Oct 16.

Carbon broken

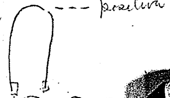


Res O.K.

No 47 Lot 1

11.30 P.M Oct 16 –

Carbon broken



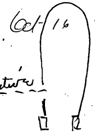
Res burnt

✓ No 18 Lot - 2

2.30 P.M. Oct 16

Carbon broken

No resistance



1190
30
1220
1

1310
5
1315

13. Lot 2.

4.05. P.M. Oct. 16.

(A lamp on which Edison was experimenting was short circuited, the "recoil" broke # 13.)

All in a heap.

No resistance.

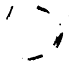
√ 51 Busted at 4.45
Oct 16 1880

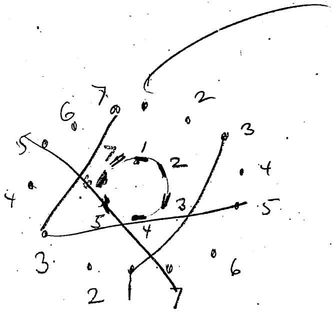
positive

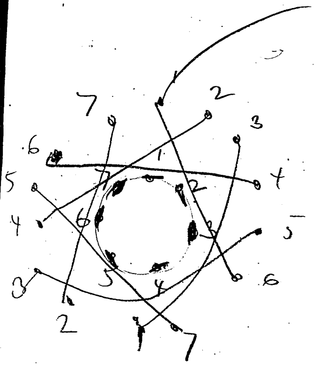
1310
45
1355

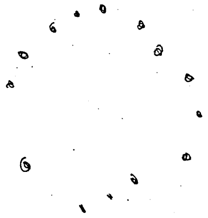
No 40 Broke Monday morning
Oct 18- when the engine started

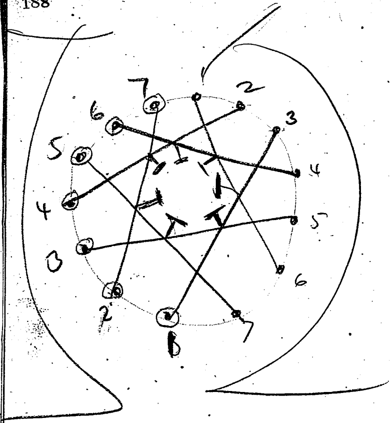
Negative
Side

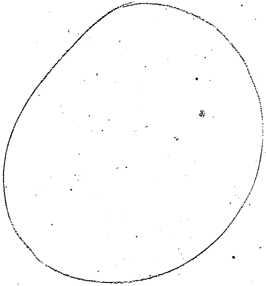


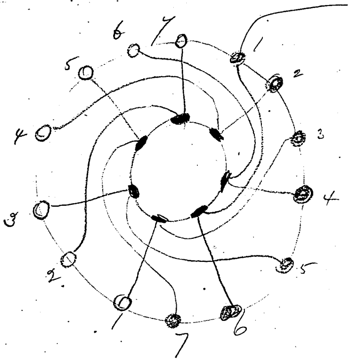

7
6
2
5
3
4
4
5
3
6
2
1
7

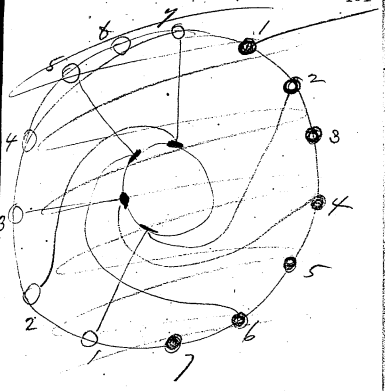


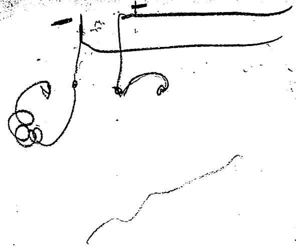


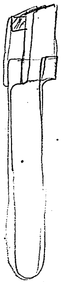

7
1
2
6
3
5
4
4
5
3
6
2
7




6
7
1
2
5
4
3
3
4
2
5
1
7
6


7
1
5
2
4
3
3
4
5
2
6
1
7





48
52
100

310
310
~~100~~) 620

21.6
6
432
1293
13362

21.6) 125 (58
1080
1700
1728 290

26
16
13
16
7
10
16
7 | 104 | 14
7
34
28

A - F = 12
F - A = 16

Menlo Park Notebook #150 [N-82-12-21]

This notebook covers the period December 1882-May 1885. The entries are by John Ott, E. D. Kellogg, and H. de C. Hamilton. There is also one entry by Edison on carbon filament experiments. The name of Martin Force appears as a witness. Included are notes by Ott on experiments with carbon filaments, clamps, vacuum pumps, and electric meters. There are also notes by Kellogg and Hamilton on insulation experiments and notes by Hamilton on condensers, storage batteries, chemically treated wrapping paper, and bleaching by electricity. The label on the front cover is marked "Sept 4 80." The book contains 264 numbered pages. The last few pages have been torn out of the book.

Blank pages not filmed: 182-183, 190-264.

2

Dec 21 1882 Tues

Tips of Carbon filaments Carbonized

Lampblack & Syrup dont hold on filament. ~~porous~~ hard Carbon

Lampblack & Rosin good Carbon holds well — not as well as Lamp Black and Tar J. F. Ott MNF

Lampblack Syrup & Anth. dont stick to Carbon at all - porous Carbon J. F. Ott

Lampblack & Pitch - porous no good —

TAE.

Landp black and Tar quite good adhears to filement. J. F. Ott.
M. N. F. [illegible]

Dec 21. 1882

Lamp Black Gum copal Pulp Paper & Burnt Gyp

Nothing left

TAE

M. N. F.

Pitch and Tar

Verry good

Lamp Black & Antiacom

Nothing left TAE
~~J. F. Ott~~
M. N. F.

Plumbago & Pitch

Nothing left

TAE

M N F

Plumbago & Syrup

Nothing left

Plumbago & burnt sugar.

No good

Plumbago Syrup & Anticene

fair TAE

M N F

Plumbago & Anticene

No good

Plumbago & Syrup

No good

TAE J. F. O. H.

M. N. F.

Dec 28, 1882

Carbonized ~~[illegible]~~ Manila fiber twisted found it worked well carbonized hard glosy black.

J. F. Ott
M. N. T.

TAE

Plumbago. Tar & Pitch
fair

TAE
M N T

Jan 6 1883

Carbonized Bambo piber in Linseed oil brought up to tempiture of 600 deg For, worked well
Also Mella fiber

J. F. Ott
M. N. T.

TAE

Jan 16. 1883

Made clamping devise to clamp fiber so as to solder it to copper wire of inside part of lamp without heating Carbon above the thick part
Soldered one with silver
" one with Tin

Also soldered with the current using the wires as conductors thera braking there forming an arc fusing the metals together also using two carbon pencels forming an arc. Also found that one pencel works well

Joe
J. F. Ott
Jn 22nd

Jan 16. 1883

Plated ends of fiber
then tined them, Also
tined end of Copper wire,
then soldered them together
with soldering Iron

J. F. Ott
M. N. F.

JAE

Jan 11. 1883

Twisted Manilla Fiber
put in moulds and sent to
Lamp Factory Newark to be
Carbonized.

J. F. Ott
M. N. F.
TAE

Jan 11, 1883

Made up a mould of
Carbons and laid side by
side with the fiber a
thin filiment of lead
about twice the diameter
of the Manilla twisted
fiber, When the fiber
Carbonized the molten
lead combined with the

oxygen given of by the fiber or other substance in the mould therefore the fibe will be saved

Also tried Zinc
" " " Copper
" " " Iron
" " Tin foil

John F. Ott
M. M. F.
TAE

Jan 16, 1883

Soked Carbon moulds in Linseed Oil, boiled then then put in fibers and Carbonized.

J. F. Ott
M. M. F.
TAE

Jan 18, 1883.

Made up a lot of fibes laid out straight with one fiber twisted around them Also three fibers braided together, Also six fibers as three some braided tight some loose

J. F. Ott
M. M. F.
TAE

Jan 18, 1883

Made a device for holding carbon and inside parts while admitting them to the flame for soldering and soldered them with differing grades of silver solder

J. F. Ott
TAE
M N e F

Jan. 24, 1883

Sent 54 Manilla twisted fiber to Lamp Factory to Carbonize they were twisted some Two Three Four Five. and Six then doubled and twisted again

J. F. Ott
TAE
M N F

Also braided same
Also laid Four and five fibers straight and twisted one fiber around in one direction and one in the other

TAE M.N.F

Jan 26, 1883

Sent another lot to Lamp factory they Carbonized well

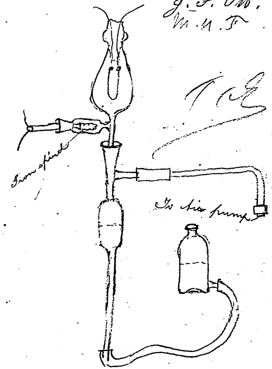
J. F. Ott
J. C. E.

M. N. F.

Lamp Exp   Feb 3. 1883

Had glass blower make the following devise per order of T. A. Edison.

J. F. Ott.
M. N. F.

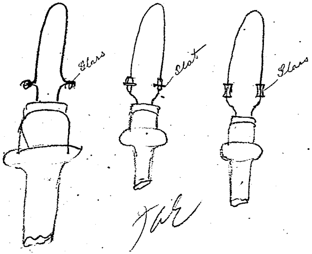


T A E

Lamp Exp   Feb 5. 1883

Plated Carbon filement on both ends, then drawn small glass tubes sliped them over the plated part also the inside parts then fused them together

J. F. Ott.
M. N. F.



TAE

Lamp Exp Feb 10 1883

Twisted Manilla fiber tied them over a forms, then imarsed lower part in Constrated sugar before Carbonizeing them

J. F. Ott

J. [illegible]

M N P

Feb 12, 1883

Finished Machine to twist very fine wire around end of fiber and inside parts so as to make a perfect contact between inside wire and of fiber

J. F. Ott

J. [illegible]

M N Y

Lamp Exp — Feb 12, 1883

Twisted fiber, put in moulds and sent to lamp factory for Carbonizing

J. F. Ott
T A E
M N J

Feb 12, 1883

Taken a solution of bastaxien mixed by Mr Edison incarsed end of fiber so as to enlargen the end where contact is made to Copper wire.

Also incarsed tissue paper then wound the end

J. F. Ott
T A E
M. N. J.

Lamp Exp   Feb 13, 1883

Made small devise for twisting end of Copper wire on inside parts a taper spiral forming a cup shape to hold fiber untill plated together

J. F. Ott.
F. A. E.
M. N. F.

Feb 19. 1883.

Coated ends of fibers with Bassorin Marked Order No 1.

F. A. E.

Feb 20. 1883

Coated ends of fiber with Bassorin marked Order No 4.

F. A. E.
M. N. F.

Lamp Exp — Feb 20. 1883

J. F. Ott

Sent Tin brushes with Iron wire to Mr Andrews to be tested on Dynamo for Carring capacity, Heat. and Sparks

TAE

M. N. F.

Feb 20. 1883.

Lamp Marked Order No 1

A. Copper wire twisted in spiral shape then reamed out and fiber pressed in.

TAE

M. N. F.

Feb 20, 1883

Order No. 6. South American fiber twisted 8 strands

TAE

M. N. F.

Feb 20, 1883

Order No. 7. fibers with enlarged ends with Bassorin disolved in equal parts Water and Amonia

F A E
M N F

Order No 5. ends imearsed in ~~sugar~~ sugar before carbonizing

F A E
M N F

Order No 8

the endire length of fiber saturated with solution marked Order No 2

F A E
M N F
J F Otto

Lamp Exp Order No 2

Tragacanth water & Amania
on end of fibers

T A E
M N F
J F Ott

Order 3

T A E
M N F

Tragacanth & Amania strong
on end of fibers J. F. Ott

Order No 4

T A E
M N F

Bassorin
Tragacanth treated with
water untill swelled up
then poured off, somore
water used untill all the

solible Stuff gone away
~~then~~ treated with alchol
acutated with Hydrochloric
Acid then pressed to squease
it out & thea disolved by
heat in strong Amonia
Sa Bossorin 1X of
Thease fibers were only
treated on ends to unite
all fibers as one J. F. Ott
M N F
J W

Lamp Exp Order No 9

The entire lengths of fiber
treated with solutions marked
Order No 2 J W
M N F
J F Ott

Order No 10

The entire length of
fiber treated with
solution Marked Bossorin
Order No 4. J W
M N F
J. F. Ott

Order No 11
J. F. Ott

The entire length saturated with solution marked No 3 Ammonia strong

Tal
M. N. F.

Order No 12

Two fibers double straight coted with solution marked Order No 2

Tal
M. N. F.
J. F. Ott

Lamp Exp

Order No 13

Two fibers straight TAE
coted with Order No 3

TAE

TAE

Order .14. March. 3. 1883

Fiber coated with bassorin,
eight in number, drawn through
draw plate put on foot of
bristol board TAE J F Ott
M N F

Order .15 TAE
M N F

Twisted fibers with foot or
ends made of card board and
fastened with bassorin

J. F. Ott March 3. 1883
M. N. F TAE

Lamp Exp. March. 5, 1883

J. F. Ott

Saturated Gum Tragcanth in water untill soft put in a Syringe and forced out in shreads and ~~left~~ dry. Then cut grave in with saw and sliped fiber in with same moistened Gum, put in moulds and sent to ~~Lamp~~ Factory for Carbonizing.

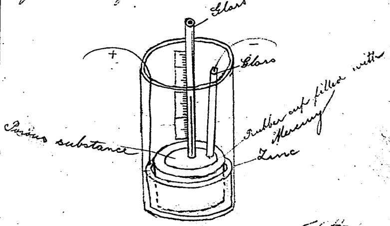
TAE M. N. T.

March 6. 1883

Made carbon clamp by winding the wire on a flat ~~[illegible]~~ mandrill then placing a flat wedge alongside the carbon

March, 6, 1888

Made Meter after the following principle



J. F. O. H.
M W F

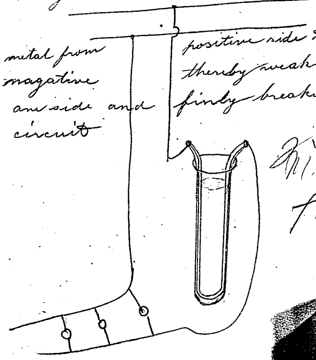
JKV

Motor Exp March 6, 1883

Made safty plug in following manner, the object being that part of the current flowing through the solution carring some of the

metal from
magative
one side and
circuit

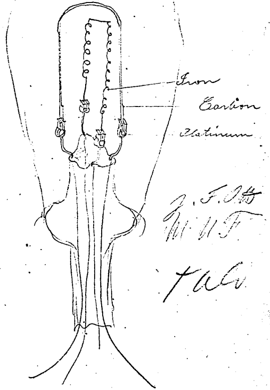
positive side to
thereby weakning
finly breaking



H.F.O.D.
M.N.T.
FWE

March. 6. 1883

Made lamp with two spirals and one carbon



J. F. Ott
M. N. F.

TAE

March 8, 1882

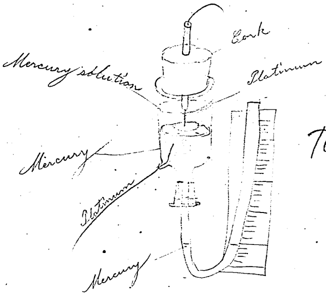
Made lamp with Aluminium clamps and leading wires

Jno W

MNF

March 8. 1882

Lamp made Meter after the following principle



TAE

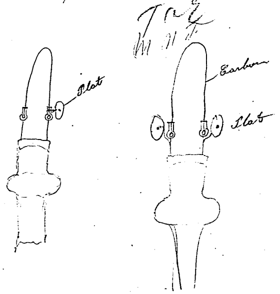
J F Ott

MNF

March 9, 1883

J. F. Ott

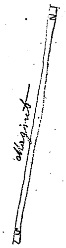
Made lamps 2 with One platinum plate one side of clamp, and 2 with plate on each clamp

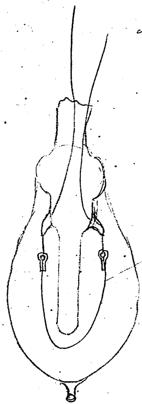


Lamp Exp

March 9, 1883

J F Ott

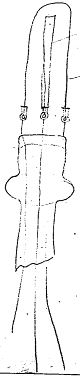




Edison v Thomson } Edison's Exhibit F

March. 9, 1883

Made lamp with soft Iron plate between carbon loops



Lamp Exp

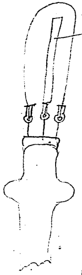
Edison v Thomson } Edison's Exhibit G

March 10, 1883

J F Ott

7/11 [illegible]

M H [illegible]

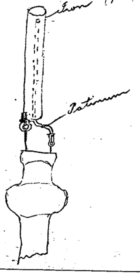


Carbon ×
Aluminum ×
Zinc ×
Tin ×
Leda ×
Magnesium ×
Platinum ×
Copper ×
Silver
Phos i bronze
Babbit
Nickel ×
Gold ×
Silver fine
Oxidized

March 12, 1883

Made an experiment
by sealing in a lamp bulb an
Iron tube conected to one pole
piece of platinum wire to other
pole but not in conection with
each other

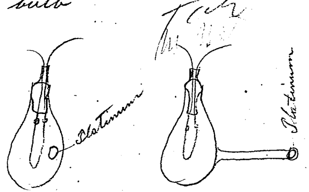
TAE J. F. Ott
MNF



March 12, 1883

J. F. Ott

Made two lamps with piece platinum blown in side of bulb



Clamps to clamp
Carbons in Lamps

March 16, 1883

Hammered platinum wire, then drawn through draw plates, leaving small hole in end to put fiber in, fastened fiber with lamp black and coal Tar, then coated the entire wire with lamp black & Tar, baked, untill gasses evaporated, Then imearsed carbon in water, gently blowing flame on clamps, and socket ~~and~~ fully carbonizing the compound

John F. Ott
M. N.

March 19, 1883

J. F. Ott

Mixed sugar and lamp black, carbonized found it to blister

Mixed lamp black and Karocene, Crumbled off

Mixed lamp black and Linseed oil, crumbles off

Tar and Graphite sticks quite well, difficult to aply

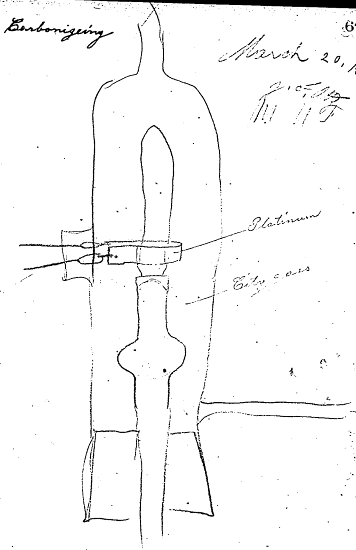
TAE

M N F

Carbonizeing

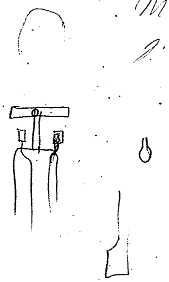
March 20, 1883

W. H. F.



March 20 1883

M, N, F
J. F, ~~Ott~~



March 21. 1883

~~Made~~ device for clamping carbons and plating hydro carbon on lower ends by imearsing in oil, and passing current through

J. F. Ott

March 26. 1883 J. W. H. F

Made two lamps with gold leaf between loops

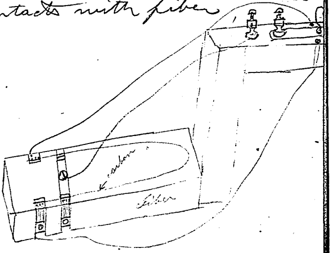
March 27. 1883

Altered clamping device to following principle

1 having clamping device laying flat so that carbon can readly be handled,

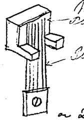
2 second the springs being made of wire instead of sheet so as to mak a larger number of

contacts with fiber



J. F. Ott.

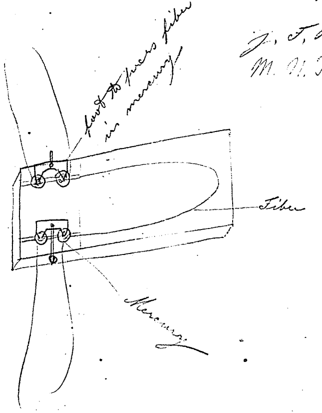
M. N. F.



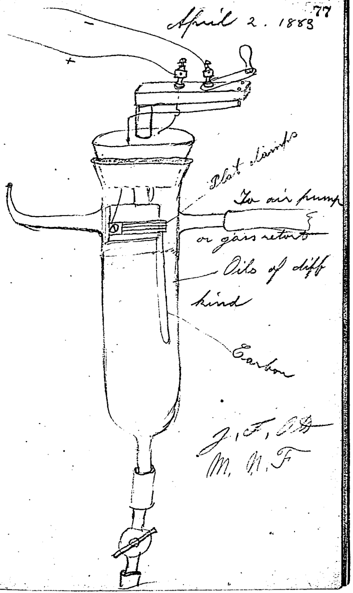
Carbonizing or Depositing Hydro Carbon on lower part of fiber

March 27, 1883

J. F. Ott
M. N. F



April 2. 1883

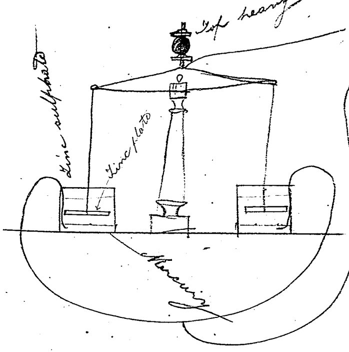


J. F. Ott
M. N. F.

April 3, 1883

J. F. Ott
M N T

Made and tested meter



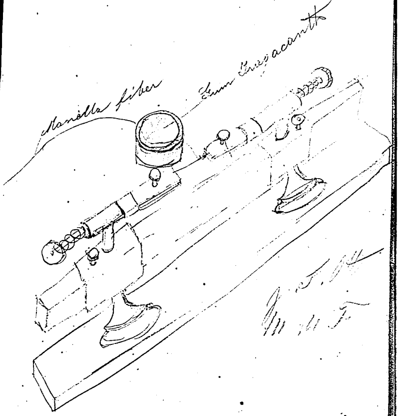
April 3, 1883

Drawn Manella fibers through Gum Tragacanth tied over a forme left dry cut of different grasses that were hollow split one side and sprung over fiber and fastened with Gum Tragacanth

J. F. Ott

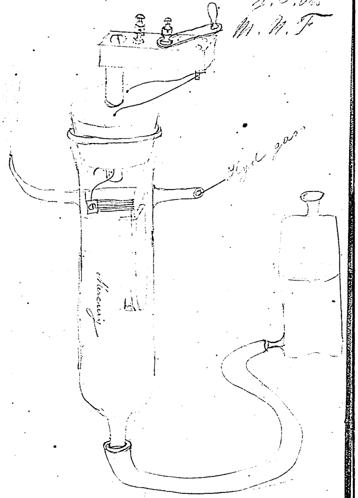
M. N. F

April 4, 1883



April 11, 1883

J. F. Ott
M. N. F.



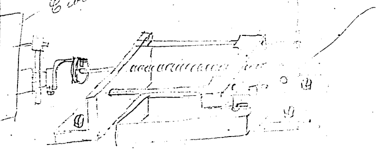
Made small clamps by
flatning plat wire then drawing
through draw plate small enough
to take fiber without [illegible]
then sliping sleeve over to spring
clamp together and being large
enough to radiate heat of. prevent
temperature raising to red heat

[illegible]

[illegible]

April 12, 1883
J. F. Ott
M. M. F

Clock

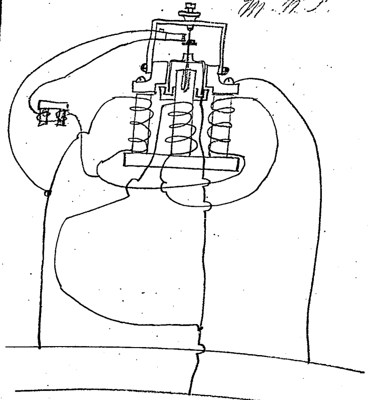


Tested this Model, and
it give quite fair results

For making Carbon fibre by Hydrocarbon
deposit

Meter May 17. 1883

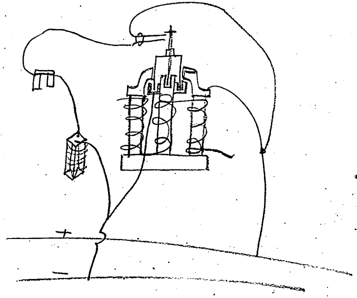
J. F. Ott
M. N. F.



Meter

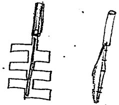
May 17, 1883

J. F. Ott
W. H. S.

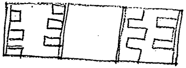


May 17, 1883

J. F. Ott
M. N. F.



Fan

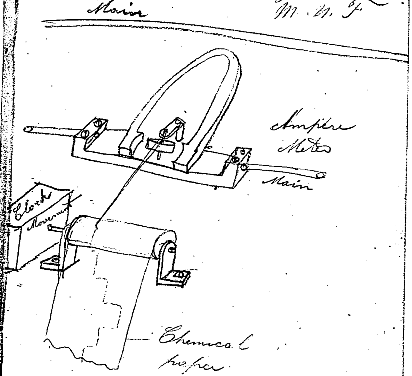


Dash pots
for Meters

June 4, 1883

J. F. Ott

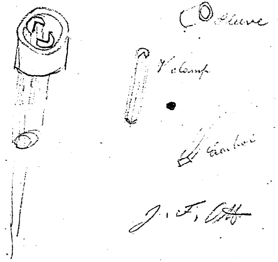
M. N. F.



June 14, 1883

M, N, F

Had Bergmann make rolls to make clamp to hold bamboo Carbons known as Village plant Carbons and also sleeve to slide over them the wire was rolled V shape, and sleeve round



J. F. Ott

July 9, 1883
M. N. F.

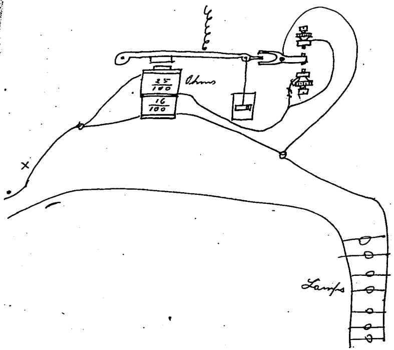
Found that a solution of Permanganate Potass made a very clear mark on paper while the Permanganate Potass fades and the mark remains perminent.

Good for rapid telegraph

J. F. Ott

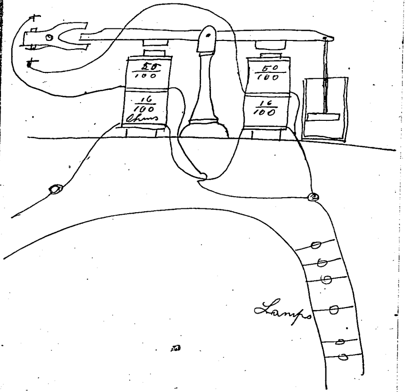
Meters

July 24. 1883
J. F. O



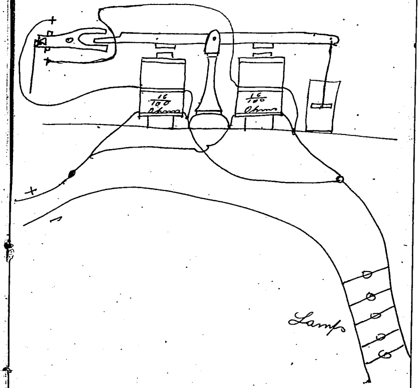
Meter

Aug 3. 1883
J. F. O



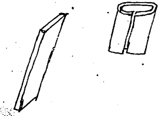
Meter Aug 3. 1883

J. F. Ott



Aug 6, 1883
J. F. O
M. N. T

Made clamps by rolling round copper and Platinum wire flat and sealing them to Platinum wire on Inside parts of lamp then making flat sleave to sute, different withs to take carbon with foot or without.



Sizes of wire used on page No. 111.

New York Aug 6 1883

J. F. Ott M. N. F

Size of copper wire used for making new clamps (Large size) or platinum

.016 wire will make clamp
.003 Thick
.051 wide
.080 will make sleeve for clamp
.010 Thick
.110 wide
.150 Length to cut ~~clamp~~ sleeve

1. Die .072
1 Punch .072
1 " .052
1 Core { .052 wide
.012 Thick

Small Size

.012 wire will make clamp
.003 Thick
.030 wide

Same size wire used for sleeve except that they are cut shorter

.096 Length to cut sleeve

1 Die .052
1 Punch .052
1 " .031
1 Core { .031 wide
.012 Thick

Aug 21. 1883

Bought tisue paper to make Carbon fillements of, by paisting a number of sheets to gether and cutting out the required sizes bending them then Carbonizing them

J. F. Ott

E D Kellogg Aug 25. 1885

Mixed different oils with different Compounds to make Insulation Compound

Hemlock Gum & Rosin. very brittle
Tar & Burgundy Pitch very fair
Resin & Chalk no good very brittle
Hemlock gum & chalk no good very brittle
Tar & Starch very fair quite hard
Tar & Chalk too soft did not put enough chalk in
Tar & Resin Got too much tar in made it to soft
Resin & Insel Oil. made it with too little oil at first then got too much in could be made very good I think
Hemlock Gum & Linseed Oil. would be very good without much Oil put in too much

Hamilton, Aug 25" 1883

Gum Damar & Raw Linseed Oil. — good
" " , Fusel Oil & Resin. — good
" " + Oil Cade. — too brittle
" " + Cotton seed Oil = gummy
" " + Castor Oil — too soft but "
" " + Paraffine Oil. — fair
" " , Resin & Chalk. — brittle.
" " , Flour & Castor Oil — fair
Burg Pitch & Linseed Oil. — too soft.
" " + Cotton seed Oil — too soft
" " + Castor Oil. — too soft.
" " , Linseed Oil & Chalk, too thin
" " + Paraffine Oil — fair.

E D Kellogg Aug. 25 1883

Resin + Linseed Oil Brittle
good but too soft " " with more oil

Resin + Paraffine Oil soft
Put in too much Oil

Tar & Hemlock gum good but
somewhat Brittle could better it
by adding a little Oil

Hamilton. Aug. 27" 1883.

Gum Myrrh & Castor Oil. — won't mix
" " & Linseed ". — " "
" Zanzibar & Castor Oil. — won't mix well.
" Copal & Castor Oil — very good.
" " & Linseed " — ~~too~~ brittle
" " & Cotton seed Oil. — too ".
" " & Olive Oil — brittle.
Gum Sandarch & Castor Oil — very good.
" " & Linseed Oil. — brittle N.G.
" " & Cotton seed " — " N.G.
Gum Amber & Castor Oil — won't mix well.
" " & Linseed Oil. — " ".
Gum Benzoin Castor Oil. — fair but brittle
Gum Zanzibar & Castor Oil. — too soft.
Gum Copal & Castor Oil. — good.

Resin Tar + Linseed oil good
but soft

Resin, Hemlock gum + Cottonseed Oil
good but somewhat Brittle

Resin + Cotton-seed Oil good but
little bit to soft

Hemlock gum + Cottonseed oil
very soft

Hemlock gum + Castor oil
very soft E.D.Kellogg

Hemlock gum Castor Oil + Gum Myrrh
very soft, gum myrrh did
not mix with other things

Hemlock gum + Paraffine oil
good but brittle
with more oil, two soft

Hemlock gum + Oil Cade
very brittle add more Oil

Red Lead Resin + Linseed Oil
very Brittle
with more oil still brittle

Gum Damar & Castor Oil. - fair. this time.
" " & Paraffine Oil. - too much gum.
Burg Pitch & Castor Oil. - fair
" " & Paraffine Oil. - too brittle
" " & Cotton seed Oil. - gummy.
Gum Zanzibar & Castor Oil - won't mix well.
" " Castor Oil & Sulphur. - no good.
" " Cotton seed Oil. - won't mix
" " Linseed Oil. - gum won't dissolve.
" " & Oil Cade. - won't mix well.
Burg Pitch & Petroleum wax - too brittle
Zanzibar, Tar, Sulphur & Castor Oil - N. G.
Gum Damar & Petroleum wax - too brittle

Aug 27 1883

Red Lead & Tar. very good

Red Lead, Resin & Castor Oil -
very Brittle tried 2 all brittle

Red lead Resin & Paraffine Oil -
tried 2 grades all brittle

Chalk Resin & Paraffine Oil -
very good

Chalk Resin & Castor Oil -
very good E D Kellogg

Hemlock gum & Olive Oil -
good but soft

Resin & Olive Oil - Brittle

Gum Ammoniac & Castor Oil
no good gum dont mix with
oil

Gum Olibanum Rd. lead & Linseed Oil
no good gum dont mix with
oils.

Gum Zanzibar & Oil Myrbane — N.G.
Burg Pitch & Oil Myrbane. — fair but too soft
Benzoin, Oil Myrbane, & Petroleum wax, & Fire Clay — will not mix well.
Asphaltum & Petroleum wax — fair a little soft
" Petroleum wax & Clay — too thin.
Hemlock Gum & Oil Myrbane — good
Aloe Capens will not disolve in Oils.
Balsam Tolu & Castor Oil. —
" " & Linseed Oil — brittle. N.G.
" " Linseed Oil, Clay & Tar — brittle
" " & Petroleum wax — too brittle
" " Petroleum wax & Tar — " "
" " & Tar — rather good.

Gum Zanzibar + Anilin Oil – N. G.
" Damar + " " – pretty good
" " + Oil of Tar – fair, little brittle
Burg Pitch + Oil of Tar – a little brittle
" " + Anilin Oil. – " "
Catechu + Castor Oil, wont mix at all.
Read Lead + Petroleum wax – too soft.
Fire Clay + Oil of Tar – N. G.
Balsam Tolu + Oil of Tar – fair, a little soft.
Resin, Chalk, + Oil of Tar – too brittle.
Balsam Tolu + Anilin Oil. – not tough enough.

Aug 29 1883 EDKellogg

Resin + Linseed Oil fair - too soft.
Asphaltum + " " very good
" + Oil Myrbane good
" + Castor Oil wont mix
" + Olive Oil fair too soft
" + Paraffine Oil very good.
" + Cotton-seed Oil fair

~~Resin~~

EDKellogg

Asphaltum + Aniline Oil fair
" + Oil Tar good
Resin + Aniline Oil brittle
Resin + Oil Tar good.
" + " Myrbane good
" + Petroleum wax too Sticky
Aniline Oil + Hemlock gum good

EDKellogg

Sept 3 1883

Gum Camphor + Aniline Oil dont mix
" " Aniline Oil + Resin good
Gum Arabic + Oil Myrbane dont mix
Gum Camphor Oil Myrbane + Resin too soft
" " Palm Oil; very good but little soft
" " Paraffine Oil + Resin very good
" " Linseed " + " very fair
" " Oil Tar + wood tar good
Tar + Oil Myrbane good
" " + Sulphur fair
" + Aniline Oil good
" + Palm " U.G. dont mix

E D Kellogg

Hamilton Sept. 3rd/1883.

Gum Thus & Castor Oil - not tough enough
" " & Linseed " - " "
" " & Cotton seed Oil. - too gummy.
" " & Paraffine Oil. - " "
" " & Anilline Oil. - too brittle
" " & Oil Myrbane. - " "
" " & Oil of Tar - too brittle
" " & Petroleum wax. - too soft.
" " & Palm Oil - brittle.
" " & Copal Varnish. - too brittle.
" " Copal Varnish & Sulphur - brittle
" " & Oil of Nutmeg - too thin
" " Oil of Nutmeg & Sulphur - brittle
" " & Tar - a little too soft.
" " Tar & Sulphur - " "

E. D. Kellogg; Sept 4 1880

Gum Euphorbium + Oil Myrbane - dont mix
" " + Aniline Oil - " "
Resin + Palm Oil - very good
" + Copal Varnish - rather brittle
" + Oil Nutmeg - rather too brittle
Hemlock gum + Palm Oil - good but too soft
" " + Oil Nutmeg - good averaging 2
" " + Copal Varnish very good
" " + Oil Tar - good but not tough
" " + " Myrbane - good averaging 3
Asphaltum + Copal Varnish - good
" + Oil Nutmeg good averaging 2
" + Palm Oil good " 2

Hamilton, Sept 4" 1883

Gum Damar + Copal Varnish. - a little soft.
" " + Palm Oil - too sticky.
" " + Oil of Nutmeg - too brittle
" Sandarch + Copal Varnish - a little soft.
" Benzoin + " " - won't mix.
Burg Pitch + " " - brittle.
Balsam Tolu + " " - brittle

Sept 5 1883

Gum Assafoetida & Oil Myrbane - dont mix
Asphaltum & Petroleum Tar - not tough enough
Hemlock gum & " " - too Soft
Asphaltum & Aniline Oil - not tough enough
Aloes Succotrine & Aniline Oil - Brittle
" " & Oil Myrbane - dont mix
" " & Castor Oil dont mix
" " & Palm Oil dont mix
" " & Oil Tar dont mix
" " & Linseed Oil dont mix

E.D. Kellogg

Balsam Tolu + Palm Oil. — very brittle
" " + Paraffine Oil. — " "
" " + Cotton seed Oil. — " "
" " + Oil Myrbane. — not tough.
" " + " of Nutmeg. — too brittle
Burg. Pitch + Palm Oil. — " sticky.
" " + Oil of Nutmeg — too brittle
Gum Sandarch + Aniline Oil. — brittle
" " + Oil Myrbane. —
" " + Oil of Nutmeg — too brittle
" " + Palm Oil — wont mix well
" Senegal + Aniline Oil. — no good
" " + Castor Oil. — " "
Catchew + Aniline Oil — not tough.

——— " ———

Hamilton. Sept. 6th 1883

Gum Thus + Linseed Oil, mixed with gutta Percha dissolved in Carbon bisulphide. — very sticky.

Gutta Percha + Gum Thus dissolved together in Coal Tar. — good, and very tough.

Gutta Percha + Gum Thus dissolved together in Coal Tar + Sulphur — quite brittle.

Gum Thus, Linseed Oil + Litharge. — very brittle.

Burg Pitch, Aniline Oil + Litharge — very brittle.

Gum Damar + Gutta Percha dissolved together in Coal Tar — a little brittle, not tough.

Gum Damar dissolved in Castor Oil + then mixed with Glue dissolved in Acetic Acid — very soft and sticky. —

J.U.

Sept 6 1883

E D Kellogg

Acetic Acid Sol of Glue and Oil Myrbane dont mix but glue gets tough as it gets cold.

Acetic Acid Sol. of Glue aniline oil & Hemlock gum mix but dont get hard

Tar Starch & Gutta Percha does not get tough

Tar Gutta Percha Asphaltum Petroleum wax & Oil Myrbane gets hard but not tough

Acetic Acid Sol. Glue mixed with Asphaltum - no Good not tough

Acetic Acid Sol. Glue & hemlock gum & Aniline Oil - too soft

Acetic Acid Sol Glue + Asphaltum + Cotton Seed Oil - dont mix well not tough

Tar Asphaltum Hemlock gum + Copal gum - not tough

Tar Asphaltum gum Copal & Sulphur - not tough

Tar Asphaltum + Gutta percha - N.G. not tough.

Linseed Oil boiled down until quite thick & then mixed with Gum Thus. —
— too brittle —
Linseed Oil boiled til quite thick, then mixed with Gum Thus, together with Glue, disolved in Acetic Acid. — very soft.
Linseed Oil, Asphaltum & Calcined Magnesia mixed together — very tough.
Asphaltum & Litharge disolved together in Linseed Oil. — too soft & not tough.
Gum Thus & Copal disolved together in Tar quite tough but a little too soft. —
Gum Thus & Copal disolved together in Tar & mixed with Sulphur — very brittle.
Gum Thus & Gum Damar disolved together, in Tar. — too brittle

Sept 8 1883

Asphaltum. Gum Copal & Cotton seed Oil - tough but not Elastic enough

Asphaltum Oxydized Tar, Aniline Oil & Gum Copal - tough but not Elastic Enough.

Ditto with ~~f~~ flour. Kneaded in - brittle but tough.

E D Kellogg.

Gum Thus disolved in, Linseed Oil boiled down until quite thick — too brittle and not tough.

Gum Copal disolved in Oxydized Tar & Aniline Oil. — plyable but not tough.

Gum Thus & Gum Copal disolved together in Tar & Aniline Oil — brittle.

Gum Copal disolved in tar & then put under pressure — crumbles up.

Gum Thus & Gum Sandarch disolved together in Candle Tar — very brittle.
Gum Thus & Sandarch disolved together in Candle Tar and Linseed Oil. — too soft.
ditto, ditto, ditto, + Sulphur — to brittle.
Sandarch disolved in Candle Tar and Castor Oil — too soft and very sticky.
Gum Thus & Sandarch mixed with Castor Oil — brittle.
ditto, ditto, ditto, + Refined Asphaltum — too soft and sticky.
Hemlock Gum & Thus with Candle Tar and Castor Oil — too soft and sticky.
ditto, ditto, ditto + Calcined Magnesia — too soft and a little sticky.
Dextrine won't mix with Oil.

E D Kellogg. Sept 10 1883

Resin & Candle Tar — Brittle
" " " & Aniline Oil — Brittle

Candle Tar & Red Lead — Tough but not elastic.

Candle Tar & Asphaltum — Tough but not Elastic.

Candle Tar & Krugie's Comp. — Brittle

Candle Tar Asphaltum & Cotton-seed Oil — not Tough nor Elastic enough

Candle Tar Asphaltum Cotton seed Oil & Sulphur — Brittle

Candle Tar Asphaltum & Hemlock gum — Tough but Brittle.

Candle Tar Asphaltum Hemlock gum & Sulphur — Brittle

Candle Tar, Resin & Asphaltum — not Tough nor Elastic enough

Candle Tar Resin Asphaltum & Sulphur — very Brittle

Candle Tar, Resin & Hemlock gum — N.G. too soft

Candle Tar Resin Hemlock gum & Sulphur — Brittle

E.D.K.

Gum Sandarch & Oil Juniper Wood - brittle
" " & Balsam Peru - not tough
" " & Oil White Pine - brittle.
" " & Oil Orange - too "
" " & " Anise - too sticky.
" " & " Wormseed - too brittle.
" " & " Lemongrass - " "
" " & " Citronella - not elastic
" " & " Cubebs - too brittle.
" " & " Tansy - " "
" " & " Lemon - " "

Gum Thus & Copal disolved together in Candle Tar — too brittle.

Gum Thus & Copal disolved together in Candle Tar & Castor Oil — tough but not very elastic

Gum Thus & Copal disolved in Castor Oil. — rather elastic but too sticky.

Gum Thus & Copal disolved in Castor Oil & Copal Varnish — a little too sticky. but quite elastic. —

EDKellogg Sept. 11. 1883.

Gums Thus & Copal & Oil Cubebs - little too Brittle

Gums Thus & Copal & Cotton seed Oil - Rather Brittle

Ditto + Sulphur - Brittle

Resin Gum Copal & Myrbane Oil - Brittle

Ditto + Sulphur - Very Brittle

Candle Tar Gum Copal & Resin - N.G.

Ditto & Sulphur Brittle

Candle Tar & Refined Asphaltum - Tough but not elastic

Ditto with Gum Copal - Brittle

Candle Tar, Gums Thus & Asphaltum - Brittle

Ditto & Copal Gum - Very Brittle

Hamilton. Sept. 12th 1883.

Gum Thus & Copal disolved together in Asphaltum & Cottonseed Oil. — not elastic.
ditto ditto ditto + Turpentine — sticky.
Gum Thus + Copal disolved in Cotton Seed Oil & mixed with small portion of Gutta Percha disolved in Turpentine. — tough but not elastic
ditto, ditto, ditto, + Sulphur — brittle.
Asphaltum, Resin & Copal gum disolved together in Cottonseed & Linseed Oil. — not elastic enough.
Gum Thus & Copal disolved in Coal Tar + Cottonseed Oil. — Tough but not very elastic.
ditto, ditto, ditto + Copal Varnish. — Brittle.
Gum Thus & Copal disolved in Coal Tar. quite elastic & not very sticky.

EDKellogg Sept 12 1883

~~Resin~~ Resin Thus Candle Tar
Copal & Aniline Oil - good
but too sticky

Gums Thus & Copal Resin &
Aniline Oil - good but too Sticky

Ditto & Sulphur - Brittle

Gum Copal & Resin in Aniline
Oil - Elastic but sticky

Ditto Ditto & Sulphur - very Brittle

Asphaltum & Gum Copal in
Aniline Oil - N. G. not tough
or Elastic

Ditto with little Thus - elastic
but Sticky

E D Kellogg Sept 13 1886

Asphaltum Copal gum & gum
Thus in Cottonseed Oil - No Good
Resin Copalgum & Thus in Aniline
Oil - Very Elastic but sticky

do. do. do. do. with Sulphur - too Brittle
Resin Gums Copal & Thus in Myrbane
Oil - Elastic & Tough but sticky
do. do. do. do. & Sulphur - Tough &
Elastic but too sticky
Resin Copal & Thus in Oil Tar -
Brittle
do-do-do in Cotton seed Oil - not
tough or elastic
do do do do do & Sulphur - Brittle
Resin Copal & Thus in Paraffine ~~Oil~~
- No Good
Resin & Thus in Oil Myrbane Brittle
do. do. do. do. do. ~~and~~ Asphaltum &
Copal - Fair elastic but sticky

Hamilton, Sept 13th 1880.

Gum Thus + Copal mixed in Coal Tar + Castor Oil. — not very sticky + quite elastic.

Gum Thus, Copal, Coal Tar + Linseed Oil. — rather elastic but too sticky.

Gum Thus + Copal mixed in Coal Tar + Aniline Oil — elastic but sticky.

Gum Thus + Copal mixed in Coal Tar + Oil Myrbane — elastic but a little sticky.

Gum Thus + Copal mixed in Palm Oil + Coal Tar. — elastic but still a little sticky.

Gum Thus + Copal mixed in Coal Tar + Oil Cade. — elastic but yet a little sticky.

Gum Thus + Copal mixed in Coal Tar + Paraffine Oil — elastic and a little sticky.

Gum Thus, Copal, Hemlock Gum + Tar — elastic and sticky.

Gum Thus, Copal, Hemlock Gum + Tar + Castor Oil — elastic + sticky.

Gum Thus, Resin + Copal mixed in Coal Tar + Castor Oil. — too brittle.

Hamilton. Sept 14" 1883

Gum Thus + Copal disolved in Coal Tar and Organum Oil. — elastic but sticky
ditto, ditto, ditto + Sulphur — brittle.
Gum Thus + Copal disolved in Coal Tar & Al Spruce — elastic but a little sticky
ditto, ditto, ditto, + Sulphur — brittle.
Gum Thus + Copal disolved in Coal Tar + Al Succini — very elastic but sticky
ditto, ditto, ditto, + Sulphur — brittle.
Gum. Thus + Copal disolved in Coal Tar & Crude Oil. — elastic but quite sticky.
ditto, ditto, ditto, + Sulphur. — brittle

Sizes of stock for making
Clamps for 100. C.P. lamps

$\frac{9}{1000}$ thick $\frac{72}{1000}$ wide

H. deC. Hamilton March 7, 85.

Bleaching by Electricity.

Soaked material in salt water & passed it over two brass rollers, put on the dynamo current with resistance in circuit, & found that chlorine combined with the brass, leaving a green deposit on the muslin.

H. deC. H. March 15. 85.

Now try carbon rollers, chlorine given off & no deposit, but it doesn't seem to bleach, only to dry the muslin.

Condenser Experiment.

Dipped thin sheets tissue paper in boiled linseed oil + then hung up to dry, to use for insulation.

Caromel wrapping Paper.

Dipped tissue paper in solution of linseed oil + Turpentine ½ + ½, also linseed + Benzine, + linseed + Kerosene;

May 5th 85.

Colored the solutions with different aniline colors, dragons blood + gamboge; + perfumed it with oil anise, oil Cloves, Sassafras, White Thyme + lemongrass.

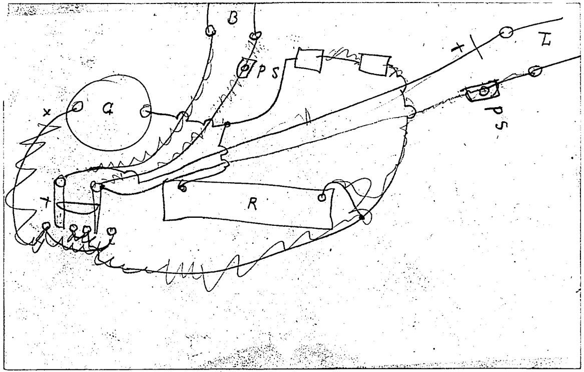
A. E. Hamilton

May 21. 85.

Storage Battery. —

Saturated soft thin paper in a solution of $Zn\,SO_4$ + $Mn\,SO_4$ + laid them between sheets of tin foil as the insulations in a condenser + charged it with two carbon cells.

[ITEM FOUND IN BOOK]



[ITEM FOUND IN BOOK]

$$\begin{array}{r} 6470 \\ 9894 \\ \hline 16{,}364 \end{array}$$

Menlo Park Notebook #151 [N-80-06-01] (NOT FILMED)

This notebook was kept in 1880 by William Carman to record fibers received from John Segredor, who traveled in the South and Latin America to procure fibers for filament experiments. (See D-80-020, Document File Series.) The cover is labeled "From Segredor" and "John R Segr." The book contains 284 numbered pages. Approximately 10 percent of the pages have been used.

Menlo Park Notebook #152 [N-80-01-13]

This notebook covers the period November 1880-January 1881. Most of the entries are by Francis Jehl. A few entries appear to be by Francis Upton. Included are notes and calculations relating to tests of A-lamps. There is also a note and drawing by Edison regarding a method for preventing the carrying of carbon by electricity. At the end of the book is a list of the number of sons and daughters of Edison and others. The label on the front cover is marked "Reg Lamp A" and "Francis Jehl." The label also indicates that this notebook is, in part, a "continuation of Book No 138 at p 39." The book contains 284 numbered pages.

Blank pages not filmed: 22-29, 130-269, 272-277.

Reg no 1

One hour high vac spark gone
Previous 491. now. ~~49~~ 182
F. Put up at 5.30 Nov 20 / 880
PM =
Busted at about 3, PM Nov 28
1880

Reg 2
~~when~~

48 Candles for hour after spark went Res 170

Bast Peat clamps 5 hours Carbonization Extra high heat.

Put up at 2.30 PM Nov 19. 1850.

Reg No 3

Bake 5 hours Reg Vac Process
1 hour no spark · 191
Put in at 5.30 · Nov 20 1880
Broke it Nov 28 - 10 am 1880
Carbon near the clamp

Req no 4

Bast 5 hours Req V Process
1 hour no spark 184.

Pifs wD at 5.30 nov 20 1550

Reg. No 5

48 candles for 1 hour after Spark R 191 Vict. Bast plat clamp 5 hour carbonization extra high heat.

Put on at 2,30 nov 19 1880

finished at Nov 28 10 am 1880

carbon near the clamp

Reg No 6

Bast 5 hour Reg process
1 hr no spark 202
10 x 1 x Bast 2 17/32 508

Put up at 5,30 Nov 20 1880

Reg No 7 1880

after hour spark gone 217
cold. originally 455 ohms

Put out at 5.30 Nov 20 1880

Reg no 8 1880

Put on at half past seven Nov ~~22~~ ~~23~~ 22

103.3 V

119.2 ohms

4000 ft.

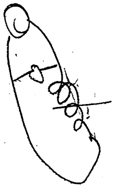
No 3

D | Up to Dec. 6. 6 PM. 164 hours

Busted at 3½ PM. Dec 8 1880 — 32 / 96 hours

2,46728
2,41821
2,41,872

~~6,41826~~
3,58174



Reg no 10 Page 77 book D

Present Reg Bust,

115 R
1525
4010 ft Cls

7.30 now ~~B~~ ~~23~~ 22

14,2126
10,
4,2126

1,343802
8,656198

3,753736 = a a + b
4,952854 = b a − b

a − b = a + (10 − b) − 10
a − b = a + ~~10~~ − b − 10

10
4,952894
5,047106

Reg No 9

127.2 R	7.30 nov ~~23~~ 22
109. V.	busted at the
4160 ft lbs.	clock 5 minutes after putting on

$$Ftlbs = \frac{E^2}{R}$$

$$R = \frac{E^2}{Ft\ lbs} = \frac{E^2}{\frac{33000}{9.47}}$$

(Reg 11)

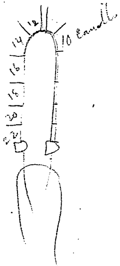
Bamboo: very high vacuum 1 hour at high incandescence. 9.47 per horse power Stark gone.

Put on at 4.30 nov 23 1880 at 16 Candles,

I marked this Reg 11 but it is not.

put up at 1 nov 24 at 48

put up at 8 pm to 40 Candles nov 23 Edison

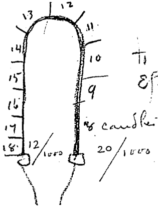


12

68
26
34
42

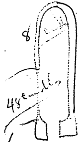
12) 162 (13½
12
42

Nov 28 1880 TAE



To prevent Electrical Carrying

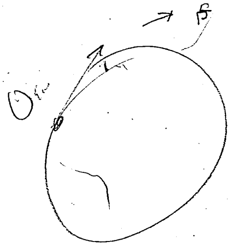
8 candles incandescent



11

17
10
11
25
29
33
18

11) 143 (13
11
33



Nov 28 1880 TAE

Bamboo 10X17

Nov 30 1880 a.m.

3-53 Started very
high globe entirely
filled with blue
very blue at clamps,
with magnet

3-56 reversed

3-59 "

4-2 "

4-5 "

4-8 "

One of the clamps
red blue very much
less and none to be
brought to the clamps
by magnet. When
current reversed the

heat left one clamp
from the other.

4-11 reversed
4-11-10 "

Intermittent

At varying intervals

Blue gone and the
carbon in both clamps
heated alike

4-15 busted
Went right above the
clamp

305	151
308	170

25127
~~4~~400

2) 39127
195.

2) 25527
127.

311	180
315	157
317	162

324

162

337	158
338	177
339	160

341	158
342	160
343	158
344	168
345	165
346	167
347	158
348	157
349	155

351	158
352	155
353	150
354	154
355	156
356	160
357	157
358	158
359	170

	360ª 166
361	158
362	165
~~366~~	
363	16.0
364	150
365	168
366	156
367	159 ~~[illegible]~~
368	168
369	159

370ᵃ 160

371	158
372	163
373	164
374	158
375	161
376	353
377	165
378	156
379	163

	380[a] 200
381	168
382	160
383	150
384	152
385	155
386	158
387	155
388	148
389	159

390[a] 155

391	154
392	no Vacuum
393	163
394	155
395	158
396	165
397	167 def
398	162
399	164

401	154
402	155
403	161
404	153
405	162
406	159
407	154
407	~~153~~ 158
408	153
409	163

411	163
412	156
413	176
414	170
415	160
416	168
417	167
418	153
419	157

425 163

433	154
434	156
435	151
436	162
374	165
438	189
439	165

441	166
442	158
443	165
444	158
445	158
446	165
447	162
448	153
449	157

451	162
452	167
453	158
455	159
454	175
456	162
457	161
458	150
459	158

$460^{\sim}$ — 163

461	155
462	162
463	165
464	161
465	162
466	190
467	160
468	160
469	162

470a 164

471	165
472	165
473	154
474	155
475	no vacuum
476	157
477	155
478	155
479	164

481	155
482	156
483	155
484	165
485	165
486	155
487	160
489	170
488	165

490^a 190

491	160
492	161
493	158
494	152
495	159
496	154
497	153
498	154
499	170

500	157
501	158
502	159
503	156
504	160
505	163
506	156
507	165
508	159
509	154
510	145
511	160

511

160

30 B
Went up in Phone room

31	78 ✓
32	84 ✓
33	86
34	84
35	88
36	79
37	82
38	81
39	82

40 [illegible] 80

41	85
42	83
43	80
44	82
45	82
46	88
47	81
48	80
49	86

51	80
52	81
53	80
54	86 ✓
55	85 ✓
56	88
58	82

520 A

512	160
523	– 169
527	160

532 153
533 153

535 162
536 163

559 | 182.

560A.164

562	166
563	165
567	167
569	-163

5

572	168
573	166 –
574	164
575	163
576	160
577	168
579	165

581	Went up in Phon. Room
582	155
583	167
586	143
587	163
589	168.

590

593	162
595	163.

11/30/80
Bast) 285) | Def 155 at 16C

11/30/80
Bast 375 | 150 at 16

Bast 289 | 155 at 16

~~Bast~~ 266 | 152 at 16

Bast 348 | 148 at 16

Bast 375 | 153. at 16

Bast 300 | 166 at 16

Lamp Jan 18 188
Lamp from Upton to be run down again. for mols

1 | 102.6 V | 98.5 n.v

2nd | 104.6 volts | 101. n.v

5 | 101.25 volts | 96.5 2.v

7 97.87 92 h.v

8 97.87 93.5 n.v

h. 102.60 n.v

½ lamp. Jan 13 1880
Jehl

No 1 163
47.93 v

2 . 164
47.93 volts

3 165
47.98 volts

4. 166.
52.65 volts

5/1 167

50.62 volts

6. 168

51.3 volts

7 169

48.60

8 170

52.65 volts

9. 171

56.7 volts

10 172

57.30 volts

11 173

50.6 volts

12 174

47.25 volts

13 180

50.60 volts

14 179

51.30 volts

no v

15 178

53.32 volts

16 177

53.32 volts

17 176

47.25 volts

18 175

47.93 volts

52.65 volts

23 185

49.27 volts

no

22 184

47.93 volts

21 183.

47.93 volts

20 182.

54. volts

19 181

57.97 volts

29 187.

49.95 volts

28. 189

47.98 volts

27. 189.

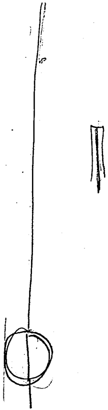
47.93 volto

26 190

57.00

25 191.

52.65 volto



J F

38 1 105

1 2
2 3.
3 4

22 23 94

1000
105
895

1000
94
906

1000
320

wires 320 680

$\frac{680}{320} \quad \frac{x}{.0187}$

680 × .0147 = 3

895 : 105 : x :: .0187

~~906 : 94 :: x~~

906 : 94 :: x : .0187

680 : 320 :: x : .0187

1

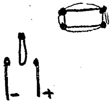
895
.0187
6265
7160
895
105)16.7365(.1593
105
623
525
986
945
415
315
100
105

2

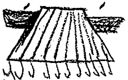
906
.0187
6342
7248
906
94)16.9422(.1802
94
754
752
222
188
34
94

3

test of Coal oil Lamp
at 48 candles ~~of the~~
to show that we can
beat a coal oil Lamp
at 48 candles



	Daughters	Sons
Gen. Palmer	2	0
U.H. Painter	2	0
Dr Wm A. Bell	2	0
Chas Batchelor	2	0
S. Bergmann	2	0
E.H. Johnson	2	0
~~T. A. Edison~~	1	~~2~~ 2
R. R. Upton	1	0
J. Kruesi	2	2



Reg 427 - 9.6 volts
Overall 8.38

	Boys	Girls
T. A. Edison	2	1
Chas Batchelor	0	2
F. R. Upton	0	1
~~Mr~~ Moses	1	2
J. L. Griffin	1	1
Mr Kruesi	3	0
Mr Dean	1	0
E.H. Johnson	0	2
McKenzie	18	9+4

22) 150 (.45

Menlo Park Notebook #153 [N-80-09-11]

This notebook covers the period September 1880-February 1881. Most of the entries are by Edward H. Johnson and John Ott. There are also a few entries by Edison and Charles Batchelor. Most of the material relates to experiments by Johnson, aided by Ott, to develop fixtures for use by consumers of the electric light. Included are notes, drawings, and instructions regarding the design of chandeliers, sockets, and interior wiring. There are also notes and drawings by Ott relating to experiments on an electric meter; drawings by Edison of the electric railroad; and drawings and notes by Batchelor on copperplating carbons in order to clamp them to lead-in wires. The cover is labeled "J. F. Ott. Meter" and "Socket." The book contains 282 numbered pages.

Blank pages not filmed: 134-139, 198-274, 277-278, 281.

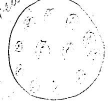
Missing page numbers: 35-36, 275-276, 279-280.

[illegible]

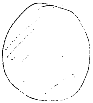
~~No.~~ Chandeliers

1

Screw + washer

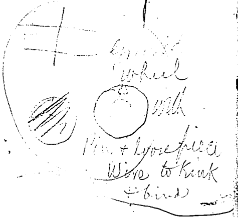


Tack on Edge



Nail in groove with Cord

Emery wheel with Pin + Loose piece Wire to Kink + bind



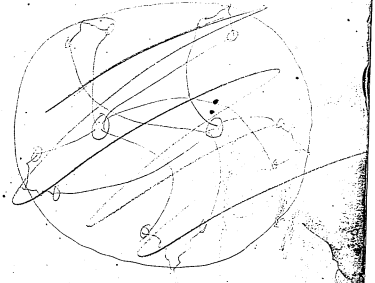
~~Eugene Phillips~~

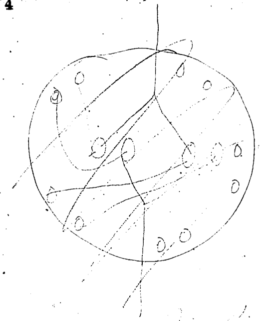
~~1 ft Candle - Every Kind Wire Ever made or cut to make~~

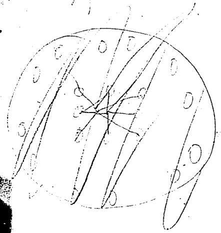
~~Sept 11/80~~

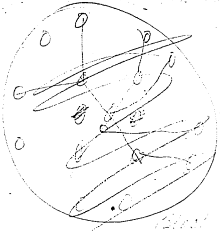
Done

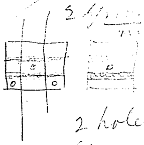
~~Benjamin Candle Samples of total ammonia~~











5/8 [illegible]
+ thick wire

2 holes to tie to
Gas Pipe

use Rubber Rings & fasten
this block with rings and
wires taut — or Spiral Springs

If 2 wires are twisted
together — Rubber bands
will hold them without
Block —

Cover Wires with
Strip brass wound Spiral

Brass Wire Spring slipped
Over Wires [illegible]
gracefully where wires
are thin and pliable

thin brass stamping
Spring [illegible] this

 or this

 [illegible] Rivets

Vulcanite tubing N.Y.
Will warp with heat
of Room

Wants
Spiral Springs for Wire Covering

See Mitchell Vance man
about shaping machines
for Ornamental work

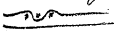
~~[illegible]~~

to Keep Dust & Moisture
Off Connection at top
of Chandelier. Slip a
Rubber Coat over Block
overlapping its Edges
& fitting Tight around
the Gas Pipe

To make - John Ott -
Insulating Block -
3. Lamp Sockets - Lamps
Wind Some Brass wire
Spirals

adopted.

3 Tacks in line. for a Wire fastening. Thus

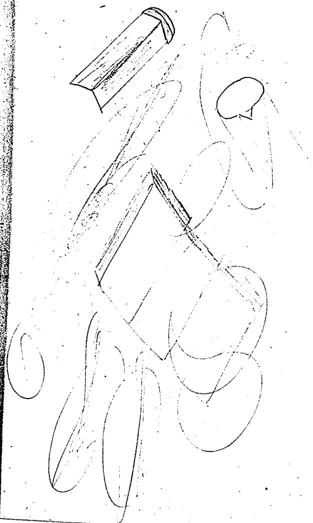


Wall Brackets

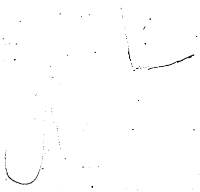
Special Wall Cap for Connections

Bear the Bracket Pipe with Spirally wound Wire to give flexibility

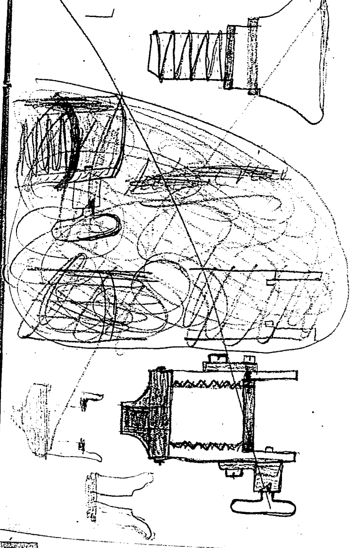
~~Wh~~ For double [illegible] [illegible] use Spiral Wire & wind the Conductors Spirally

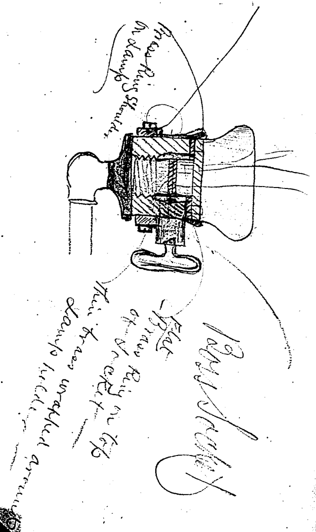


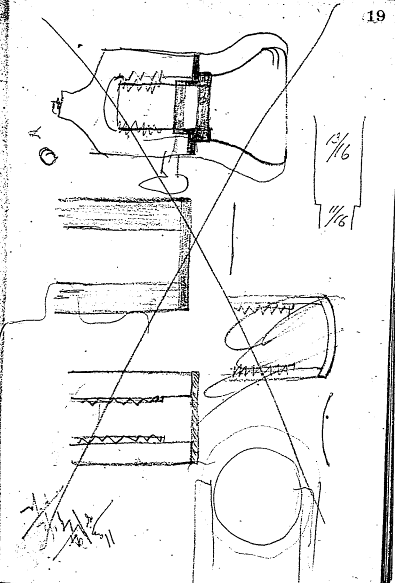
Hall Lights
To raise & lower -
use Spirally wound wire
& wind Conductors in the
Spirally



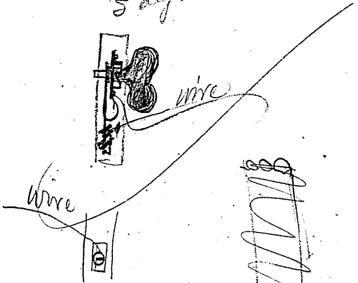
Sockets

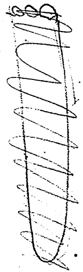


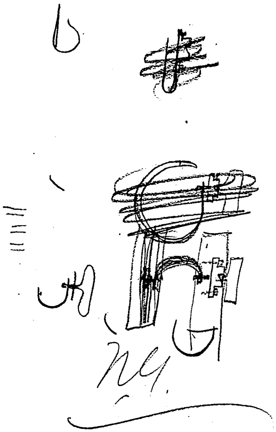

Brass Ring Shoulder
On Lamp
Boss Socket
Flat
Brass Ring on top
of Socket
thin brass wrapped around
Lamp holder


13/16
11/16

Edison says N.Y.

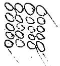




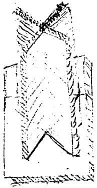


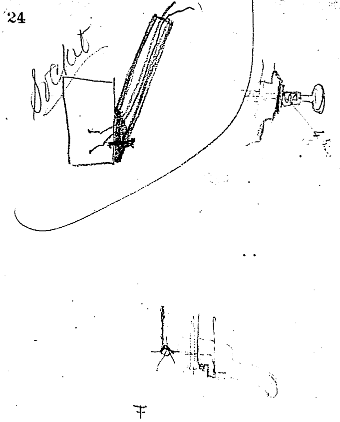
ask Edison if Metal
Can be covered
with thin Vulcanite

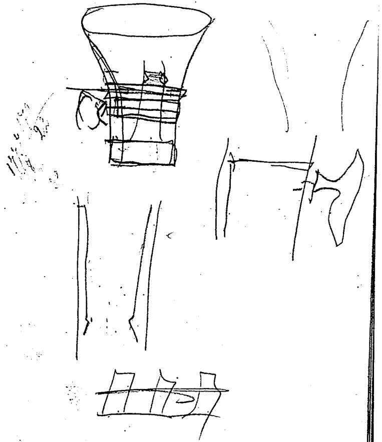
If so cover the cock
of Lamp Socket

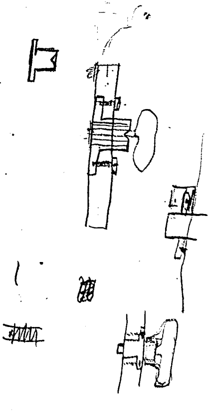


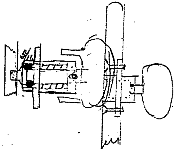
16 wires of 34 1/2 [illegible]
0.1 Diameter

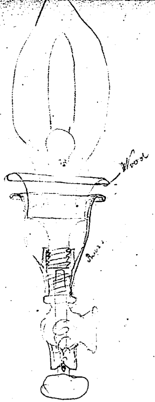


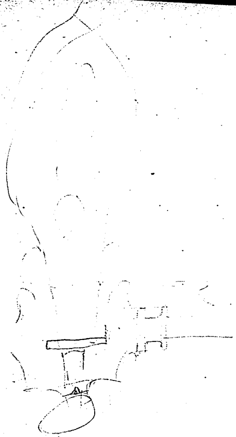


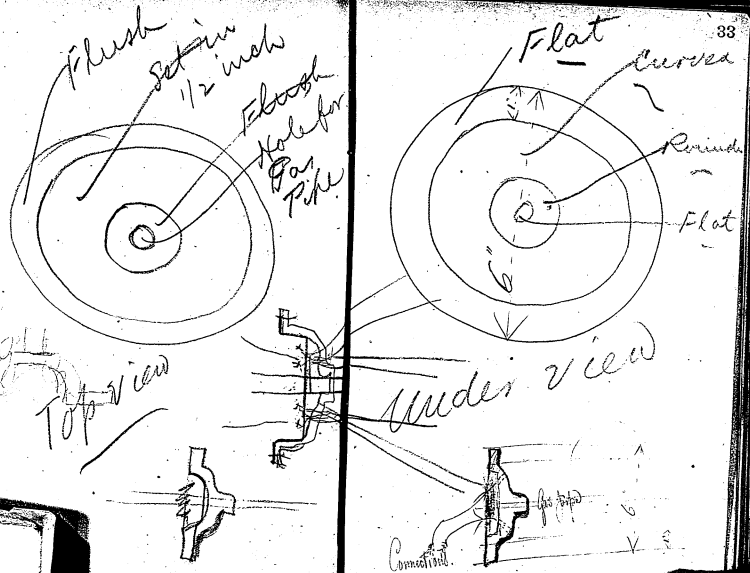


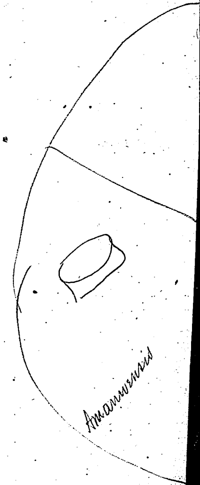




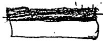

Wood
Brass

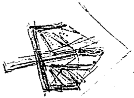



Flush
Set in 1/2 inch
Flush
Hole for Gas Pipe
Top view
Flat
Curved
Round
Flat
6"
Under view
Gas Pipe
6
Connections



Make Large Socket with
Wood Screw - Flat thread
More curve at top - 
3/8 in Tit on Glass for Cork

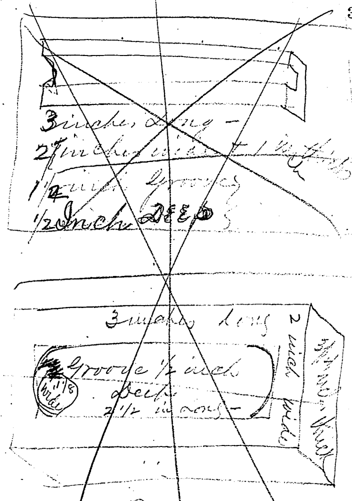




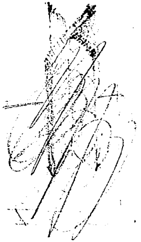
Wires

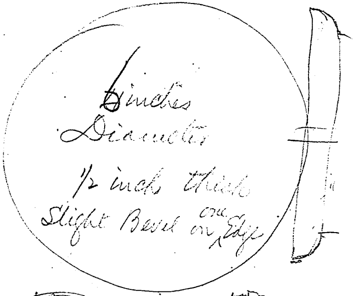
25/1000 wire copper
75/1000 Insulation
1/32 in Lead Sept 23/80

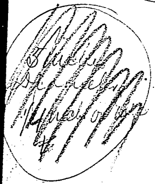
m

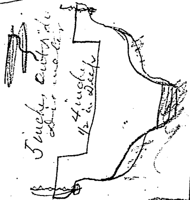


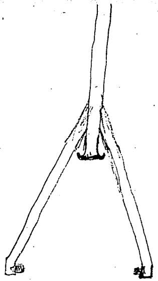
~~Straight Board Dr~~

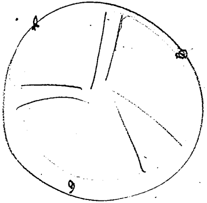


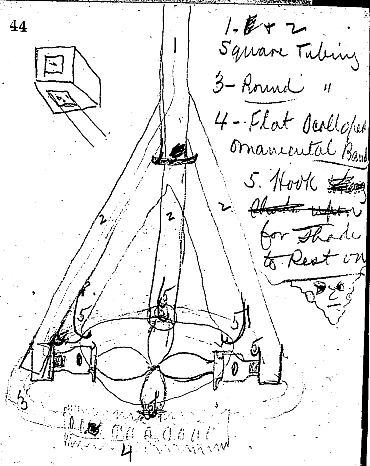

6 inches
Diameter
1/2 inch thick
Slight Bevel on one Edge



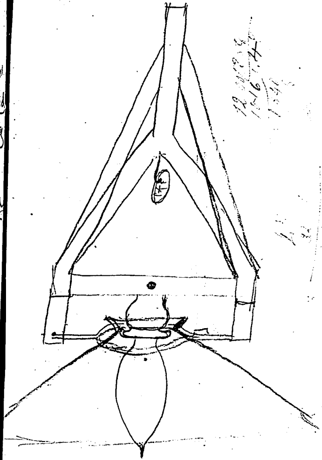

5 inches outside
4 inches
1/2 in. Deep

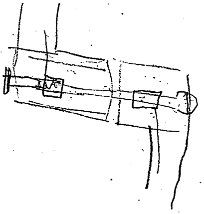


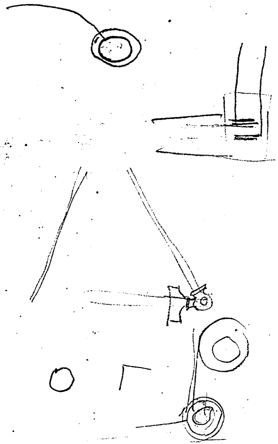


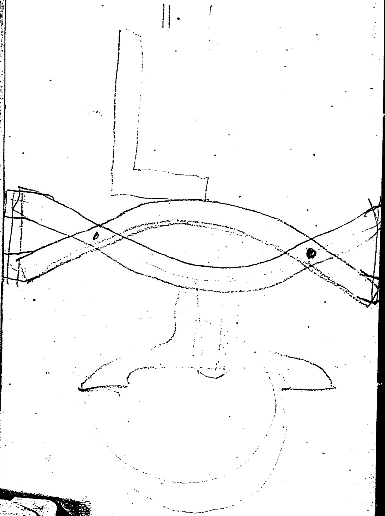


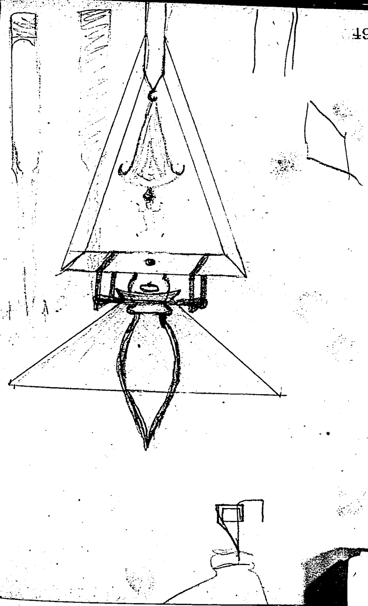
1. ~~B~~ & 2
Square Tubing
3- Round "
4- Flat Scalloped
Ornamental Band
5. Hook ~~Ring~~
~~Chain~~ ~~upon~~
for Shade
to Rest on

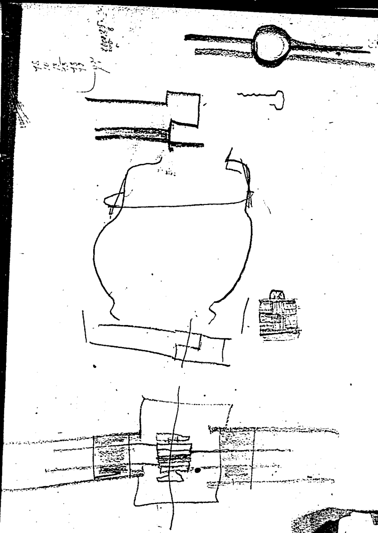




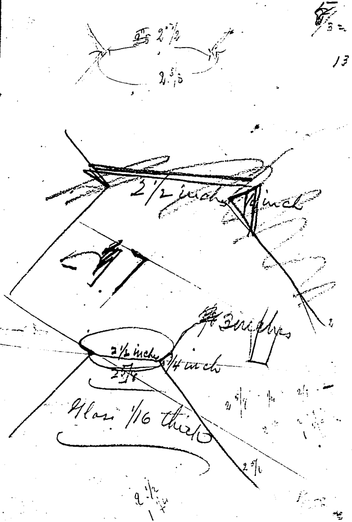


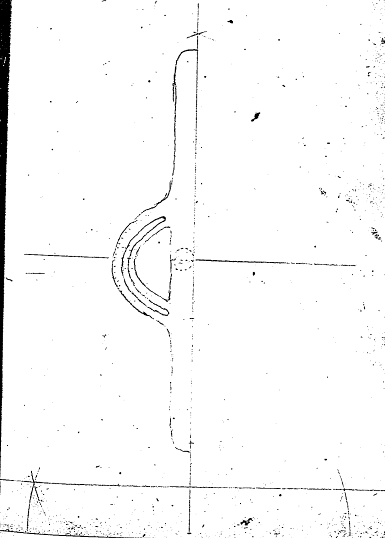


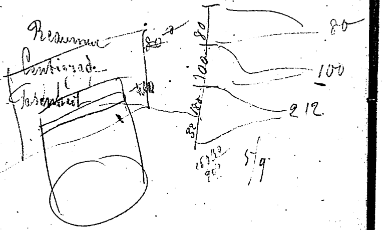


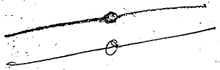


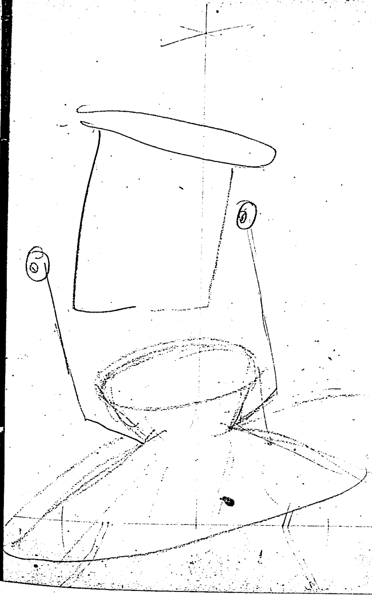
2. 3/32

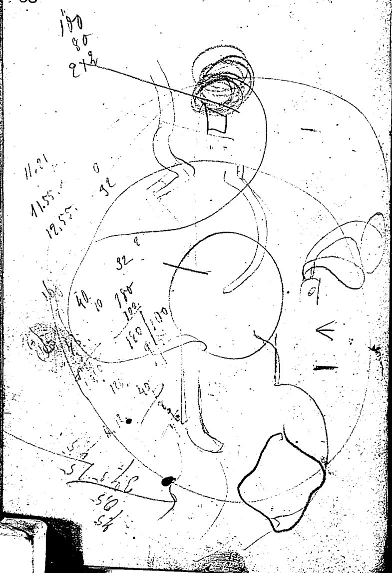

2 1/2 inches
1 inch
3 inches
2 1/2 inches
1/4 inch
Glass 1/16 thick
13

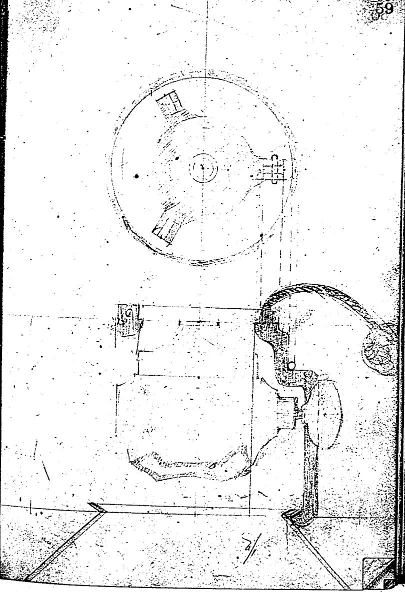


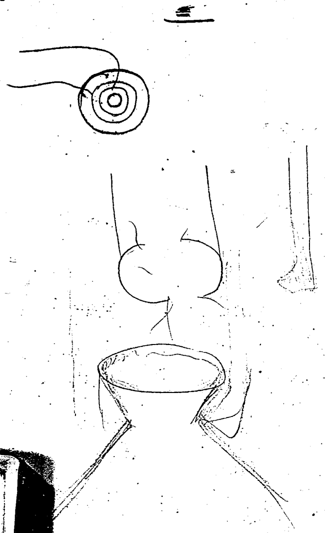

Reaumur
Centigrade
Fahrenheit
80
100
180
32
80
100
212
5/9

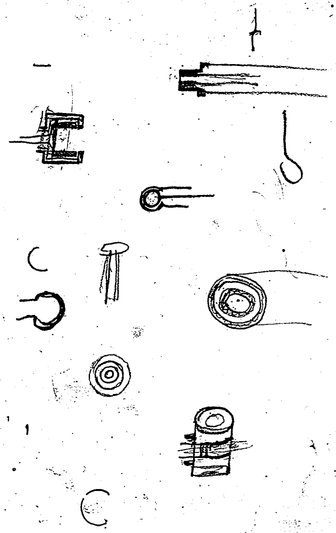




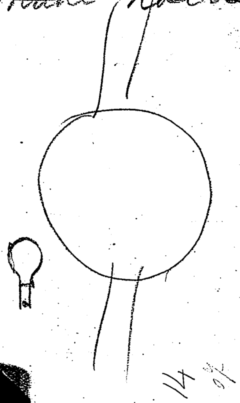


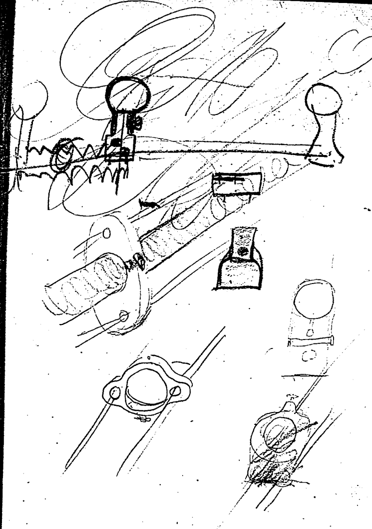


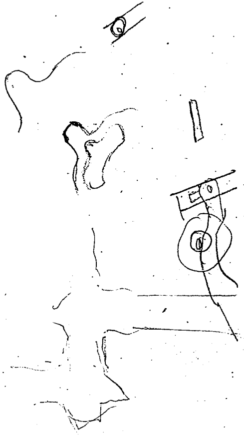


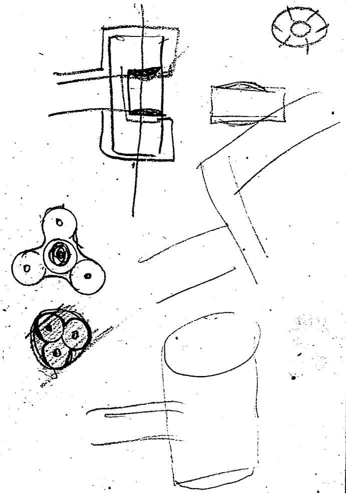


~~Go ahead on Shade Ladder.~~









2000 | 4

20
4
80

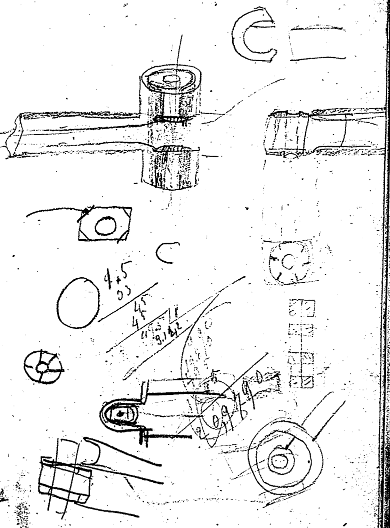
159

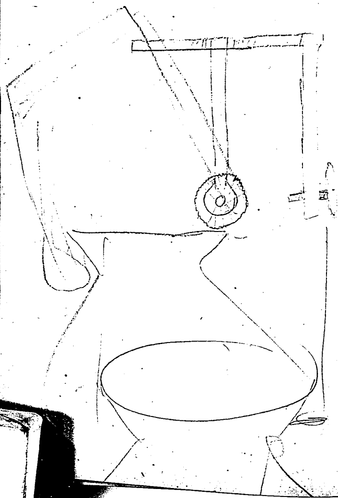
5
15
10
15

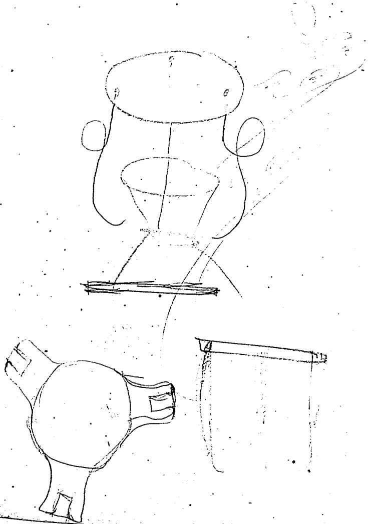
510 | 254

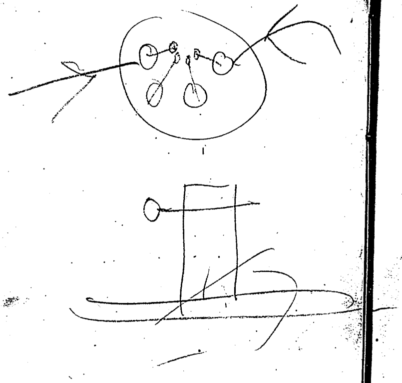
495

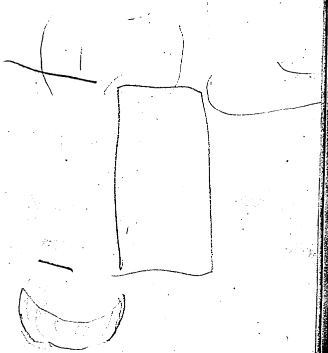
1554

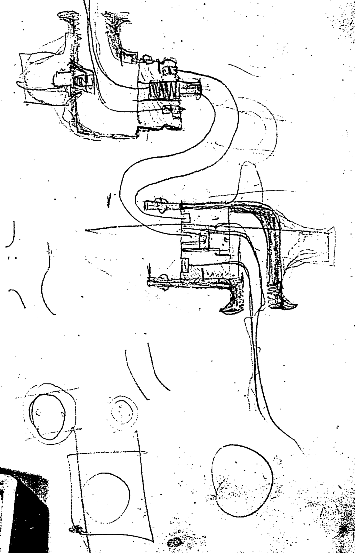


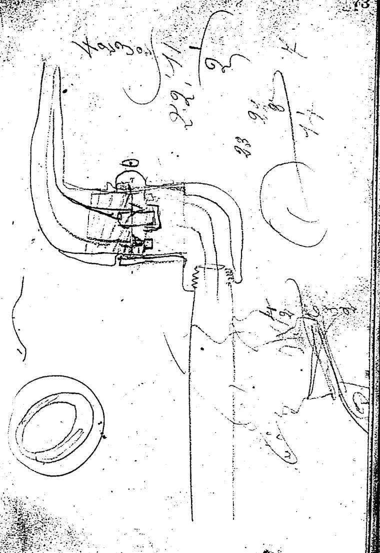


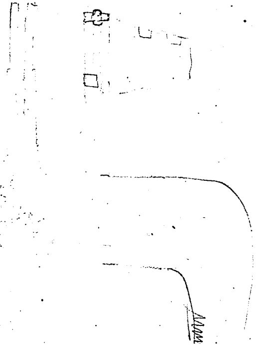


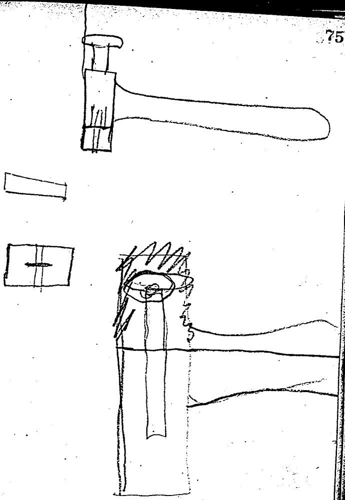


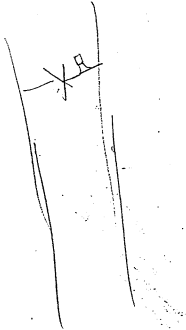


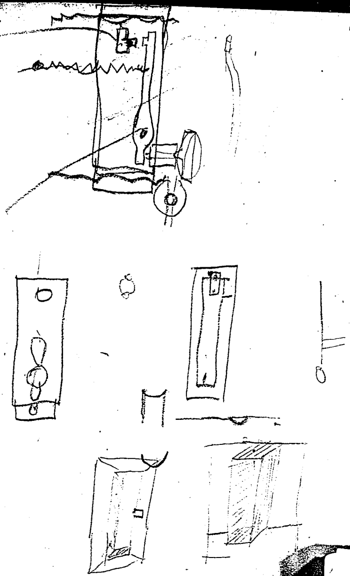


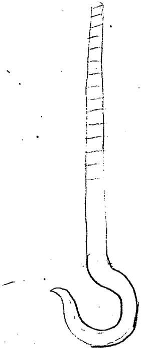


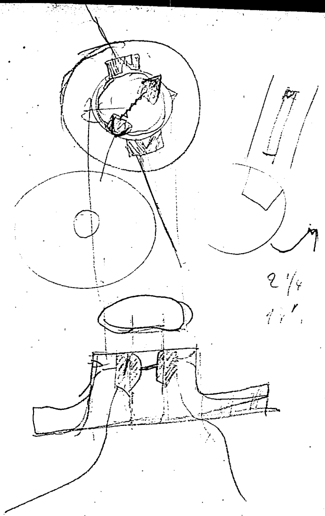


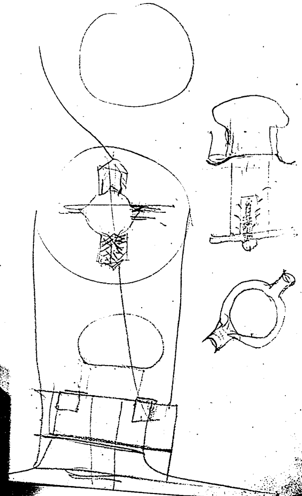


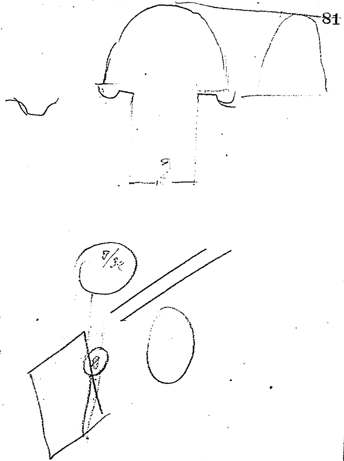


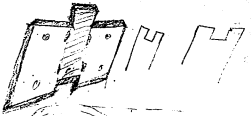


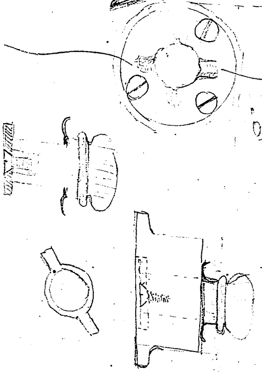



2 1/4









0.075

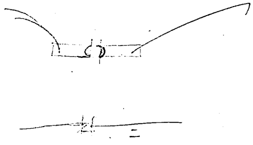
0.014
300
5.100

0.020
3
0.060

Acinent these [illegible]

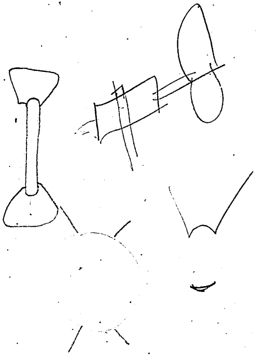
[illegible]

Mix your Plaster
with glue water
& cement [illegible]
lumps [illegible]
Do not [illegible]
cement [illegible]
wires - [illegible]
off by [illegible]

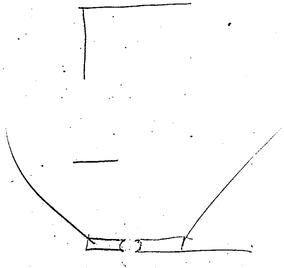


Fix this ~~[illegible]~~
Switch Same
as the other
make the [illegible]
holes [illegible]
for the [illegible]
and
cut the wire
where marked
with Pencil

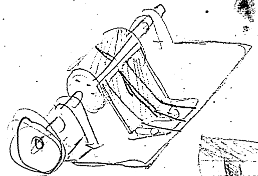
[illegible]

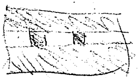


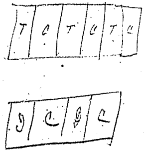
Make this



12 Nov 1880 Toh

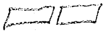




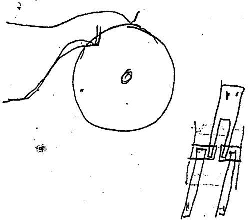


John —
Please solder
these tip cords
together neatly
so as to make
one long cord
Keep them straight
E H J

The short spring
wont do — The Ends
of the springs must
be exactly on top
of the cylinder —

The copper strips
must be split
in the centre.
thus. 

E H Johnson
over



When you finish
this job go on
with the Lamp
Sockets GHJ

14
4
56

52

4 12

-.9-

18

14
4
56

7
$\boxed{90}$ 14

8

75.8

195
12
390
195
2340
37
16380
7020
86580 = 721.5

12) 86580

35
8
280
42
40
362

1185) 2323

4) 118.5

227) 721.5 - 328
681
415
1880

29.6
1.8

4.970
362
5332

19.5
3
58.5

118.5) 8658.0
8295
3630
3556

40.0

78) 721.5

19.5
16

170) 721.5
680
415

54
6
324

44
6
264
344

037
8
296
80
376

86 single 6.1 No. 20 wire = 6.1 ohm

1185) 721.5
7110
1050

5.2
6
31.2

.52
4
208
73
1040
1456

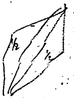
12) 151 (1268
12
31
24
70
60
100
96
4

312
45
1560
2168

12) 2600 (2168
24
23
12
100
96
4

28

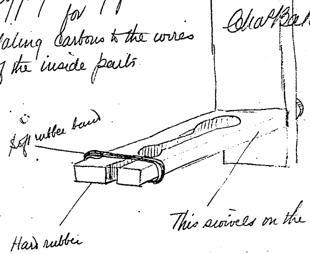
6 3 3/8
12
72
3
7.5

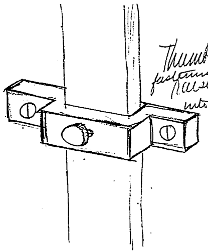


Copperplating pictures for plating carbons to the wires of the inside parts

Dec 29th/1880

Chas Batchelor





$14\frac{1}{2}$

$14\frac{1}{2} \times 2 \times \frac{3}{16}$

$14\frac{1}{2} \times 2 \times$

0625
.1875

22
11

4.70
4.70
9.40

14.5 × 2
29.4
2.196
2.094
5.586

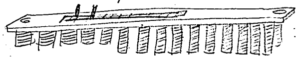
Cubic inch 220

94.0
47.0
14.1
120

5.6
.312
1 1 2
1 3 6
1 6 8
1.7 2 7 2

226

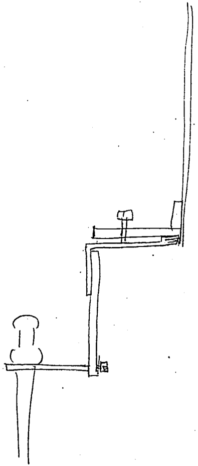
Cost of Resistance box
as made by Bergman

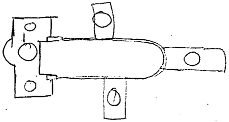


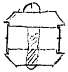
German Silver Wire

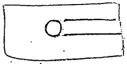
Base —— 20	.35
Wood for spools .	.20
Iron screws (wood) . 30	15
Brass wood screws 84	40
6 Brass screws for ~~Bind posts~~ Bind post ——	12
Making Spools .	1.50
6 Copper washers ——	4
Brass 2 lb at 23	46
Rubber for plugs 6 plugs ——	.10
Drilling 47 holes ——	10
Reaming 34 holes ——	10
finishing ——	1.00
Sawing ——	15
Making plugs 6	30
Assembling	1.50
	~~6~~ 6.50

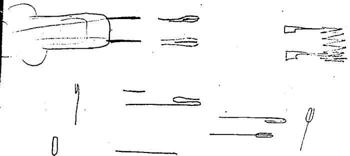
Gave Bergman Contract for
100 at \$7 each

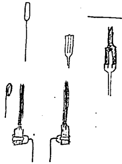










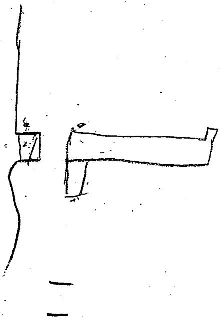


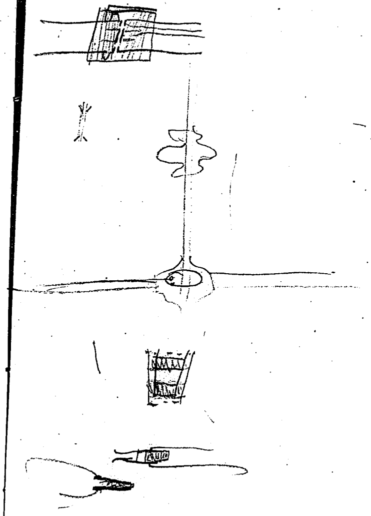
Method of clamping carbons
previous to plating them and
the wires together
Chas Batchelor
Jan 3rd 1881

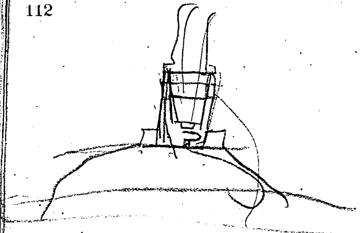
John

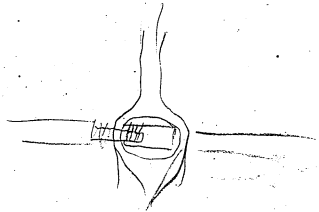
Please cut enough
Off the base tube
in the old "neut."
socket to prevent
a short circuiting

TAE

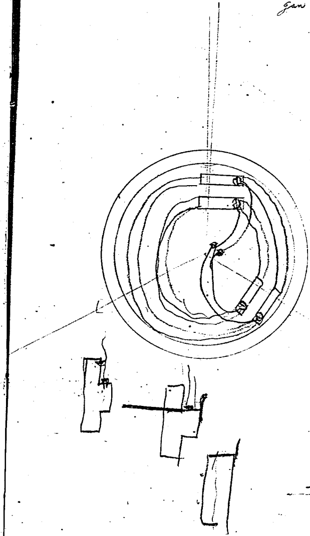


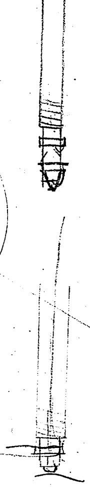






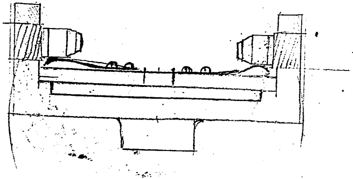
Jan 20 . 1881
John F. Ott.

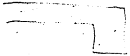




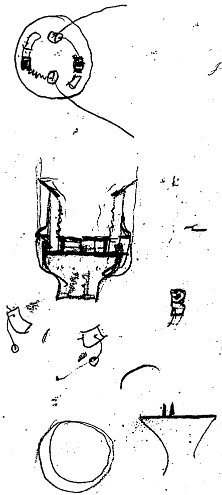
Jan 20. 1881

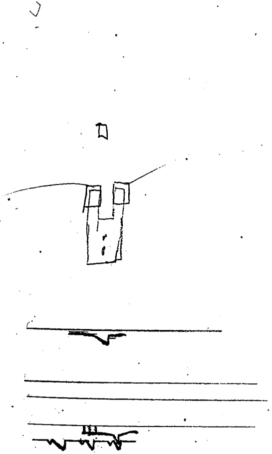
John F Ott



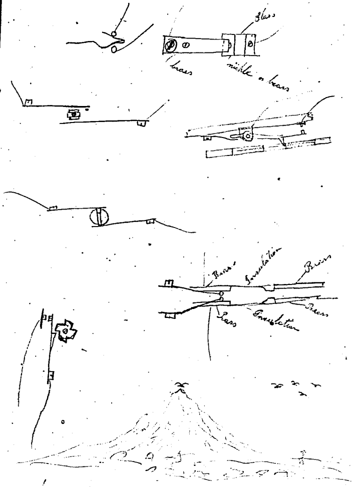


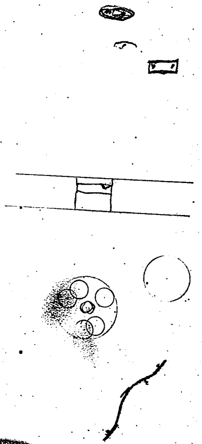
Jan 26. 1881





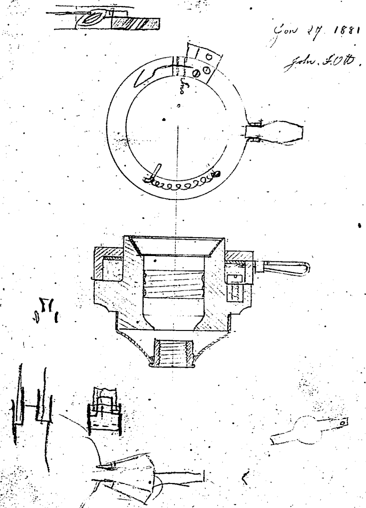
Jan 27, 1881
John F. Ott

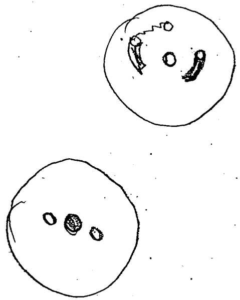


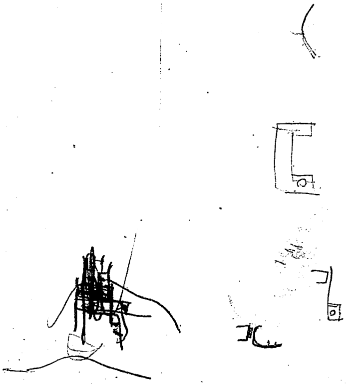


Nov 27. 1881

John F. Ott.







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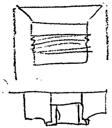
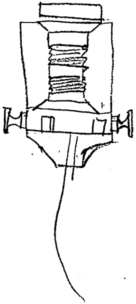
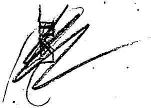
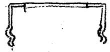
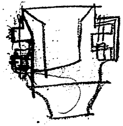


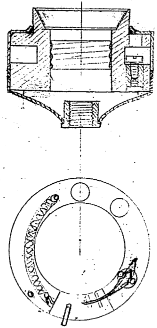


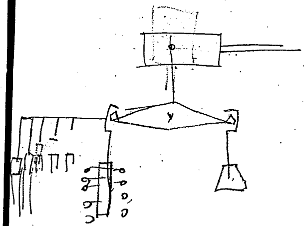






Jan 27. 1881
John F Ott

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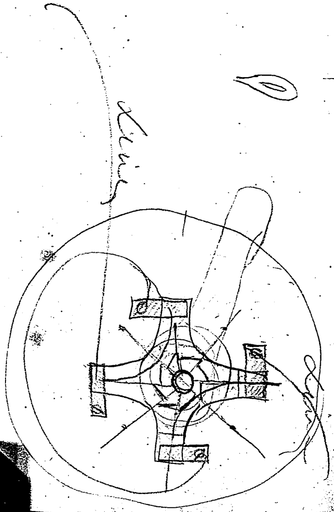
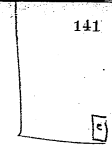
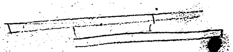
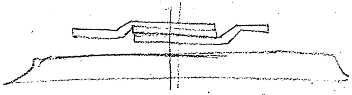
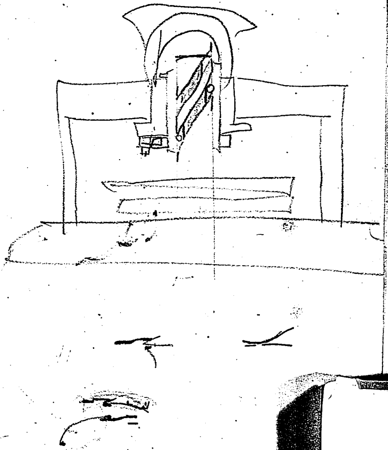
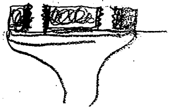


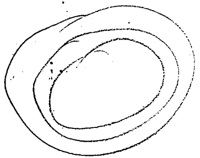


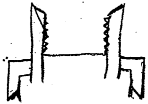


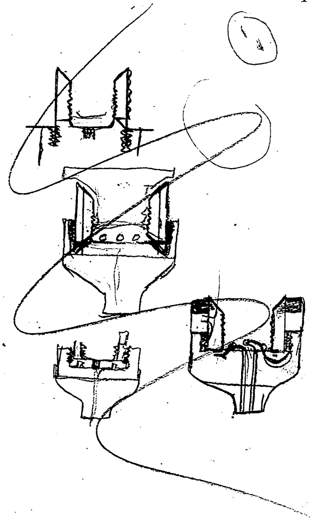












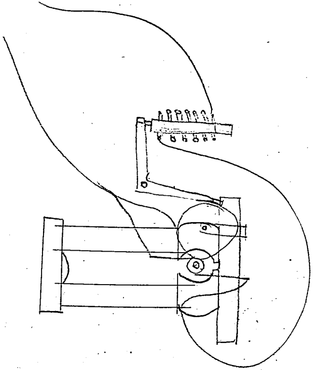
John Please
Fix this One
to turn like
the Other and
Knurl the top
Cap.

E H J

T.A. Edison

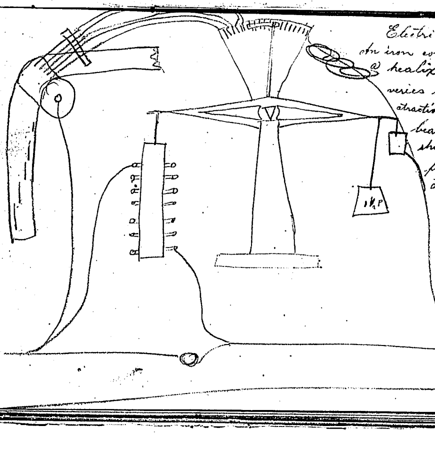
Feb 12, 1881

John F Ott



Electric Meator.

An iron core suspended in a healix, as the curent veries so will the mgnetic atraction very tilting the beam up or down shunting the curent from one pen to the other on camical paper



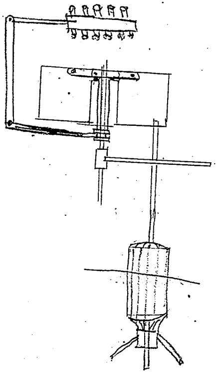
T. A. Edison John F. Ott

Feb 12. 1881

T. A. Edison

John F. Ott.

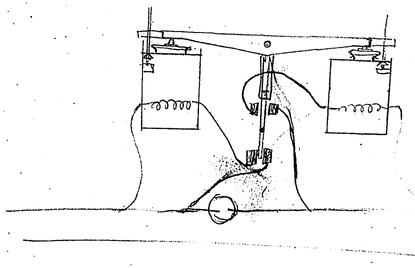
Feb 12, 1881.

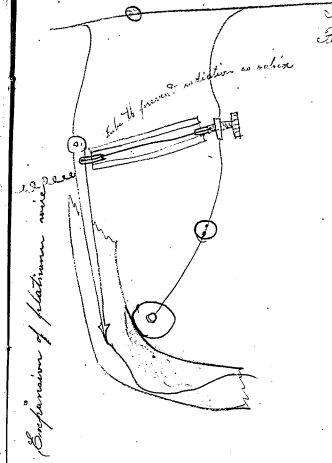


T. A. Edison John F. Ott.

Feb 12. 1881

Two air tights chambers, the curent being past through causing the air to expand acting on diafram thats acts on leaver shunting the curent in the opiset one then vice virce.





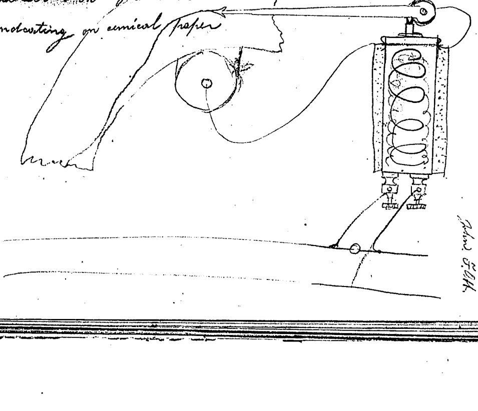
T A Edison
Feb 12, 1881
Jno. F. Ott

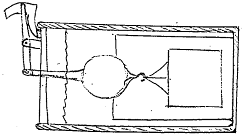
T. A. Edison

Feb 12. 1881.

John F. Ott.

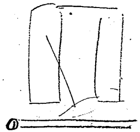
a spiral of wire inclosed in a airtight chamber and offering suffici[ent] resistance to heat when the ~~current~~ flows, and expanding the air ~~to act on~~ diafram which acts on leaver and indicating on cemical paper

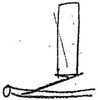




John Ott

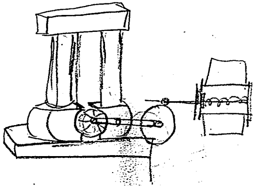
Please have the new wooden sockets which will probably come Monday— all fixed like this one— no cork wanted— use the thin German silver— & give plenty of surface contact —instead of great pressure— round the contact pieces a trifle before putting ~~the~~ the spring in— fasten it in with 3 pins from inside— make spring exactly size of this one— solder wire connection to binding post & make both B Posts alike— E.H.J.





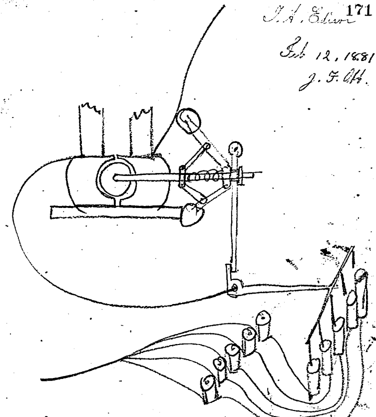
Menlo Park Jan 12, 1881

J. F. Ott

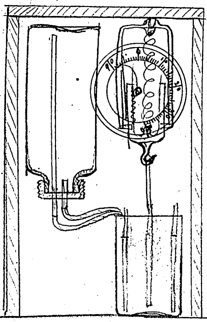


Speed regulator the fan so arranged as to open as the speed increases offering more resistance

Feb 12, 1881
J. F. Ott.

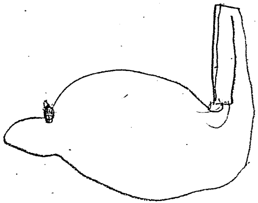


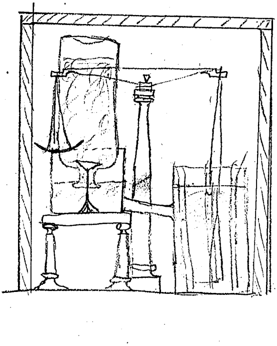
Speed regulator as the speed increases the governor opens and moves a lever and throws ~~[illegible]~~ resistance.



Automatic Solution feed, and spring scale indicating the deposit when one plate being to heavy they are to be revissed when the inspector inspects the Meator

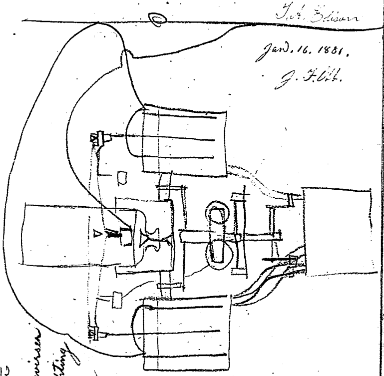
T. A. Edison
Jan 15. 1881.
J. F. Ott.





Automatic solution
face and beam scale
only to weigh when
the inspector inspects
the Meters

T. A. Edison
Jan 16. 1881.
J. F. Ott.



Tho A. Edison

Jan. 16. 1881.

J. F. Ott.

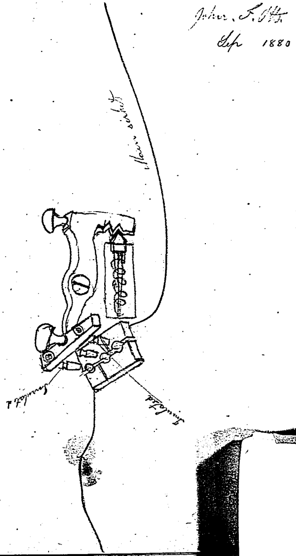
Automatic Meter without current reverser on every tilt emptying the jar and filling the opposite one

T. A. Edison

John F. Ott

Sep 1880

Nott arc switch which can be shortted by hand or foot



Meater No 3

	On Time	Off Weight	Off Time
	9 20.	1807	11.00
R	11:15.	13.20.	12.15.

8

16

6 5/8
8 1/8
14 6/8

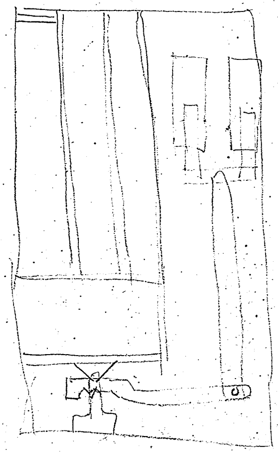
2 5/8
5 4/8
8 2/8

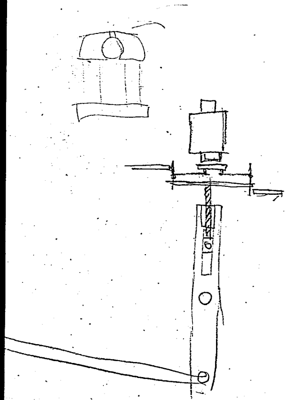
2 3/8

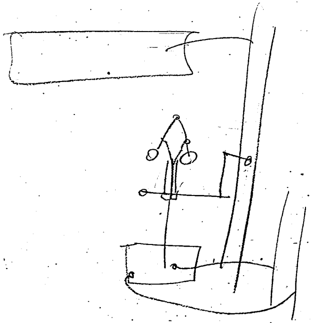
7 3/8
9
16 3/8

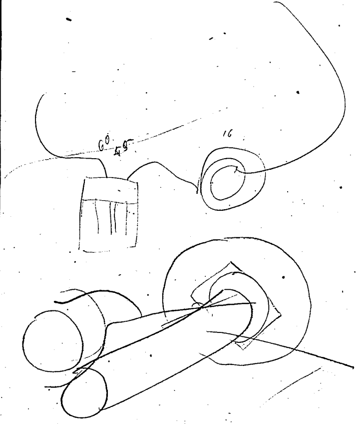
Meotts Tank No 2

Date	Time	Feet	Date	Time	Feet			
Feb 18	315							





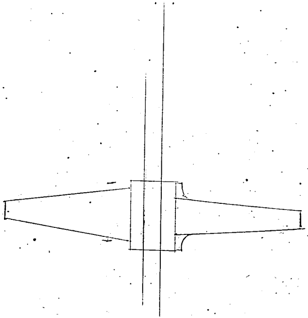


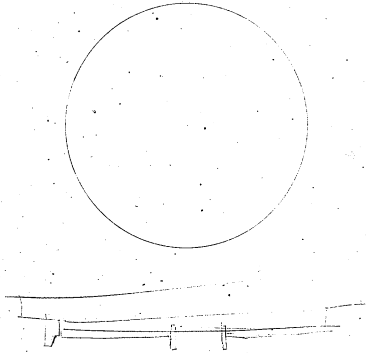

60
16

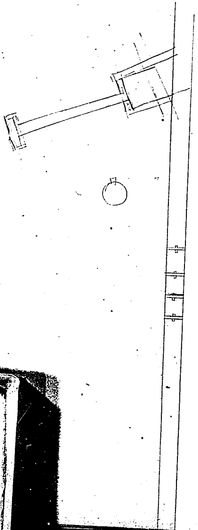
312
87
2184
2496
12) 26644 (2220 4/12
24
26
24
24
24
4 28

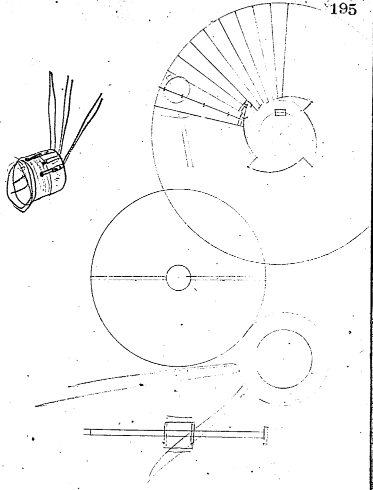
7 3/8

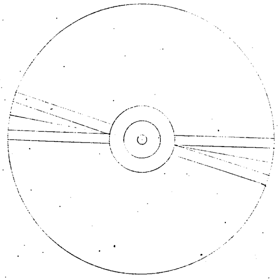
7 3/8
12
84
3
87











Pour réduire mm en pouces ang. ajoutez 0, & ÷ par 0.254

Pour réduire pouces en mm ajoutez un 0 ÷ par 4

Le [illegible] augmenté de 4/[illegible] du nombre donné de pouces en [illegible]

6
4
24

600 : 4 = 150
20
150
2.4
152.4

800

20000 | 0.254
32 | 1,800

= 2

2,54

4

Menlo Park Notebook #157 [N-80-12-24.2]

This notebook covers the period December 1880. The entries are by Francis Jehl and Francis Upton and consist of notes and drawings relating to lamp tests. The label on the front cover is marked "Lamps" and "Francis Jehl." The book contains 284 numbered pages.

Blank pages not filmed: 24-25, 94-105, 108-177, 182-284.

no 521a

185

370
123 Volts

R 18840
4300
48 C

3140
1157 Ohms

2.0899
2.0899
1.6464
1.9375
3.7670
0.5155
.7845
6812
4357

5510

.68

272 candles
per H.P.

34

68

21.6 : 129 :: 68 :
68
1032
774
21.6) 877 20 (402
872
520

201

378a

182

R 18840
4150

C 48

364
121 Vaf[illegible]

22990
1849

.0838
0838
6464
9391
7531
5185
7654
6812
4466

5560

5.82

280 candles
per H.P.

126.6

8773
1106
1237

1316

135
13

+ 2 Ohms

516ª

190
18840
.7750
(48

380
126.6 Volts

126590
132.95

1026
1026
6156
8748
7264
5185
7921
6812
4733

5330
6.2
277

~~9990~~

.9090
1106
0670
.0865

122
1167
5.3 Ohms

185

18840
4500
@46

(23340
116.7

(370
123.3

.0910
0910
6464
9380
7614
5155
7571
6812
4383

5770

6.72

274 candles
per H. P.

~~9330~~
9330
0200

953
1106

~~9766~~
10636

115.5
104.7

10.8 Ohms

513a

175a

L350
116.6

18840
2100

20940
104.7

0670
0670
6464
9800

7594
5185

7591
6812

4.403

5740

5.74

2761. candles per H.P.

9208
0364
1106
0678

117
1087
8.8

524 A

180 = 0

360
120

15840
2900
21740
108.7

0792
0702
6464
9636
7684
51.85
7501
6812
4313

5870

5.63

270 candles per H.P.

520 A Retested Dec 27

8950
0966
1106

~~1~~022 126

+2

520 ~~A~~ Dec 24

48C
191

1382
1273

18840
6150

24990
124.9

5
1050
6060
9034
7598
5785
2402
6812
~~4~~ 199

269 candles per H.P.

8893
1045
1106
8044

127

5231A

194

388
129

18840
6600
25440
127.2

1106
1106
6464
1955
7631

2369
5185
6812
4360

1997

273

9305
0671
1106
1082

1283
1167
11.6

514

176

1352
1173

18840
4500
23340
116.7

0695
0695
6664
9329
7143

2817
1997
4814

303

9066
0835
1106
1007

126
121.2
318

515 A

186

48 candles

18840
5400
24240

121.2

282

372
124

0934
0934
6464
9165
7497

2503
1997
4500

9151
0519
1106
0776

119.5
112.7
6.8

517 ~~4~~

18.2.5

1365
121.6

18840
3700
22540

112.7

~~9151~~
9849
0849
6464
9481
7643

2357
1997
4354

272 candles per H.P.

9045
0632
1106
0783

119.6
115.7
+ 4

522 ~~A~~
48 candles
187

18840
4300
23140
115.7

374
124.6

0955
0955
6464
9368
7742
2257
1997
4254

266 candles
per H.P.

9090
0942
1196
0538

183
104.2
~~278~~
87.8

427 A

185

370
123.3

18840
2800
21640
108.20

0910
9600
1942

2058
1997
4055

254 candles

~~a of Volt~~ 2 2565
amp 2.0 8 6990
amp 1.05 9.9666
0,9221
836 = Deflection for 1 Volt

7143
9221
7922
7922
6464
2873
5181

59.2

33 000 5185
3802
8981

8987

candles per H.P.

B 5 9

93.5

~~12560~~

Retested
20 cells

90.5
94
185.5

258
260
518
6279
4050

10329
57.6 Ohms

7261
9221

8030 63.5
8030
6464
2388

4912

1970
7612
8388

7970

5088
8997

4075

61.2
57.7

+ 3.5

256 candles per H.P.

20 cells 90.5 L
94 R

265
271

536

261
265

526
536

1062
531

6279
5.3 ohms

11579
57.7

7657
9221
8436
8436
6464
2000
5336
4664
8987
3651

69.7 Volts

62.4

1564
8000
8388
7952

+ 0

232 candles
per H.P.

66 B

24C

~~288~~
295
583

6279
6350
12629
63.1

7235
9221
8014 63.3
8014
6464
2774
5266

1986
7226
8388
7600

4734
8987
3721

5.76
5.2.8
4.8

236 candles for H.P.

65 B

24C
261
258
529

16279
4300
10579
52.8

7597
9221

8376 64.8 Volts
8376
6464
9884 + 0

5100
4900
8987

3887 245 candles
per H.P.

60 B

24 C

285
290

575

6279
6700

12979
64.8 ohms

7482
9221

~~6701~~ 8261 68.5
~~6703~~ 8261
~~6464~~ 6464
2069 2069

~~1939~~ 5055

+0. 4945
8987

3952

248 candles per H.P.

63B

24 C

278
282

560

6279
6150

(12429

62.14

7419
9221
8198   6.6
8198
6464
1979   + 2
4839
5161
8987
4148
260 Candles for ~~A~~.P.

64 B
24 Candles
.278
274
552
~~4884~~

6279
6420
12699
63.4

7813
9221

~~6734~~
~~673~~
8292 67.5
8292
6464
1938 + 1.5

4986

5014
8987

4001
251 - candles per H. P.

61 B

4 C

280
284

564

6279
6530

12809
64.

7528
9221
8307
8307
6484
2125
5203
4797
8987
3784

67.7

+1.2

239 candles per H.P.

57 B

24 candles

285
281
566

62.79
6000
12279
61.

75.36
9221

8315 67.8
8315
6464
1798

4892

5108
8987

4095

256 candles per H.P.

35 B

24 candles

282
285

567

6279
6950

13229

66.1

7076
9221
7855
7855
6464
3002
5176

61

4924
8987
246 3911

31 B

24 sandles

258
252
510

6279
3750
10029
50.1

7597
9221

8376 68.8
8376
6464
1978

5194

4806
8987

239 3793

46 B

24 candles

285
290
575

6279
6700
12979
64.9

7482
9221
8261 67
8261
6464
2211
5197 + 2
4803
8987
3790 239

44 03
24 Candles

277
283
560

6279
5750
12629
601

7267
9221
8046
8046
6464
2299
4855
8987
3842

63.8
63.7
58.9
4.8

1954
7701
~~8388~~
8043

242 candles per H.P.

58 B

24 Candles

768
265
533

6279
55 ab
11779
58.9

17574
9221
8353   68.4
8353
6464
2000   +.5
5170
4830
89.87
3817   241

24 candles

264
286
572

6279
6350
12629
63.14

7284
9221
8063
8163
6464
2644
5234

4766
8987
3753

64

+ $\cancel{5}$.3

23 / 7 Candles per H.P.

50 13

24 candles

265
270
535

6279
4600
10879
54.4

7308
9221
8087
8087
1464
2549
5187

4913
8787
3700

64.4

234 candles
per H. P.

36 B

24 Candles
273
265
538

6279
4850
11129
55.6

5705
9221
6484
6484
6464
4237
3669
6331
7226
3557

44.5 Volts

5185
20.41
7226

226 Candles per H.P.

B 21C

16 candles

184
188
372

6279
1270
7549
37.7

58.4
37.7
20.7 Ohms

3515
5763
8388.
7666

6064
9221
6933
6833
6464
3605
3535
6465
7226
3691

234 candles

22 C

16 candles

200
204
404

3167
8395
8385
7950

6279
2450
8729
43.6

62.4
43.6
18.8

5798
9221

6577
6577
6464
3936

3554 2226

8446
7226

3672 233 candles
per H.P.

26 C

16 candles

188
192

380

3423
6064
8388

7875

6279
1800

18079

40.39

613
40.3

21 [illegible]

5966
9221
6745
6745
6464
3915
3869
6131
7226
3357

216 candles
per H.P.

27 C

16 candles

195
200
395

6279
1850
8129
40.6

3255
6085
8388
7728

59.3
40.6
+ 18.7

6232
9221
7011
7011
6464
3316
3802

240 candles per H.P.

25 C

16 Candles

208
212
420

3050
6279
9329
46.6

2989
6684
8388
7981

62.8
46.6
16.2

5729
9221
6508
6508
6464
4045
3525

225

23 e

16 Candles

185
189
374

3492
5955
8388
7835

1600
6279
7879
39.4

60.7
39.4
21.3

5763
9221
6542
6542
6464
4157
3699

234

28 C

16 candles

185
192
377

6279
1400
7679
38.4

3458
5843
8388
7689

58.7
38.4
\+ 20.3

5694
9221
6473
6473
6664
4145
3555
6445
7226
232 3671

~~16~~ 24 ↵

16 candles

183
186
371

1420
6279
2 7699
38.5

3527
5855
8388
7770

59.8
38.5
21.3

6075
9221
6854
6864
6464
3152
3324
6676
7226
245 3702

48.5

29 C

16 Candles

200
205
405

6279
3400
9679
48.39

3146
6848
8388
8382

68.9
48.3
20.6

188 2.2742
1.3345
8.7 .9397
.7738
9397
8341
68.2 Volts
8341
6464
2821
5967
4033
8987
3020

200 candles per H.P.

B.65 Retested

Has been very high for short time
20 cells 93.5
94.5
188.0

24 C

247
247
5974

1659
7179
8388
7226

6279
4170
10449
52.24

.5 Ohm

7284
9397
7887   61.5
7887
6464
2499
4737   2990

5263
8987
4250   266

B 36 Retested

24 C

~~265.5~~

262
263
535

6279
4970
11249
56.25

2113
7501
8388
8002

63.1
56.25
6.85 Ohm

2 .7589
9397
8192 66
8192
.6464
1857
4705

5295
8987
4282 268

7634
9397
8237 66.6 1763
8237 7993
65.2 8388
63.1 8144
+ 2.

B46 Retested

24 Candles

287
574

6279
6750
13029
65.14

1808
8143
8388
8339

68.2
65
+ 3.2 Ohm

Brought up very high and retested

~~289~~ 290
290
580

6279
6350
12629
63.1

7482
9397

8085
8085
6464
1778

4412

5588
8987

4575

64 · 3 Volt

1915
8222
8388

8525

71.2
66.4

286 4.8

B 35 Retested

24 candles

280
560

6279
7000

13279
66.4

7582
9397
8185 65.8
8885
6464
1886
4720 2960
5280
8987
4267 267

B 60. Retested

24 candles

1815
8114
8388
8317

288
285
573

6670
6279
12949
6475

67.9
65.8
+2.1

7152
9397

7755
7755 59.6

B 31 Retested

24 candles

260
259

519

2245
7002
8388

7635

6279
3770

10049

5024

58.
50.24

+8.24

6990
9397
7593
7593
6464
2807
4457
5543

57.5 Volts

2407
7193
8388
7788

62.9
52.4
+ 10.5 Ohms

59 B Retested

24 candles

250
250
500

6279
4300
10.579
52.4

507 : 493 :: X : .0187

.0187

3549

4056

507

493) 9.4809 (.019

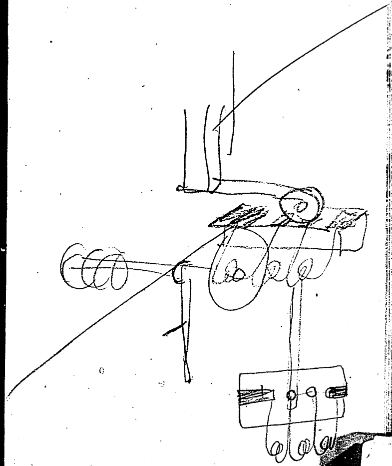
493

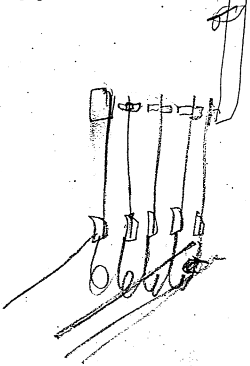
4550

3944

606

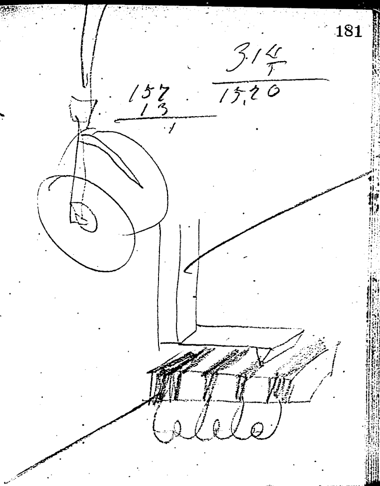
2





3.14
5
15.20

157
13
1



Menlo Park Notebook #158 [N-81-03-22]

This notebook is undated with the exception of one entry for March 22, 1881. All of the entries are by Francis Upton. Edison's name or initials appear on many of the entries. The book contains notes, calculations, and a few drawings relating to conductors for the Pearl Street district. The label on the front cover is marked "Conductors." The book contains 284 numbered pages.

Blank pages not filmed: 184-277, 280-281.

x E-172 N-81.03.22

I propose as a system to carry around each square a wire of uniform size so that only 2.5 Volts shall be lost in the wire. Also to connect in the interior each distributing point with the other points so that there will be a fall of 2.5 Volts along the distributing wires.

The increase of weight to making the cable of uniform size is 1.165 times as much as when it is decreasing.

$$\log 1.165 = \begin{array}{r} 0665 \\ 19 \\ \hline .0664 \end{array}$$

$$\text{TAE} \quad \begin{array}{r} 6.3933 \\ \hline 6.4597 \end{array}$$

Block 1

$$\begin{array}{r} 3.1314 \\ .0664 \\ \hline 3.1978 \end{array}$$

1570

$$\begin{array}{r} 3.0503 \\ .6664 \\ \hline 3.1167 \end{array}$$

1340

JM

Block 2

$$\begin{array}{r} 488 \\ 489 \\ 20 \\ 137 \\ \hline 2\,\big)\,1132 \\ 566 \end{array}$$

$$\begin{array}{r} 6.4597 \\ 2.7528 \\ 2.7528 \\ 1.5185 \\ \hline 3.4838 \end{array}$$

33

.3040

TW

Block 3

514		6.4597	
510		2.7709	
20		2.7709	
137	30	1.47771	
1181		3.4786	3081
590			

Jas.

Block 4

1020
87
20
1127
5~~1~~3

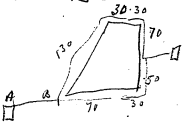
3.4

6,4597
2.7505
2.7505
1.5315
3.4922

3110

[illegible]

Block 5



20
10
81
51
162

A.B. 10 lamps to

3.2 lbs
20
640

230 1.3617
64 1.8062
3.1679

1470

2 Volts fall around block

160 lamps 5 / 1030
206
1236

3.0920
.0664
3.1584

1440

904 2.1956 2
.6664
3.0226

1.050

80 6.4567
say 200 2.4771
2.4771
0.9031
2.1140

130
4090

Block 6

4 R

3.1313
.0664
3.1977

1570

6 & 9

2.5229
.0664
2.5893

388

10
64
20
328
44
466
233

6.4567
2.3674
2.3674
12 1.0792
2.2707 186
2144

Block 8

529

3.1191
.0664
3.1855

1535

6.4597
2.0792
2.0792
0.4771
1.0952

120

3.0

12

Block 9

148
20
341
10
30
549

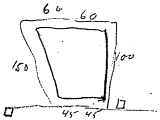
6.4567
2.7396
2.7396
1.2041
3.1400

16

3796

1380
5176

Block 9



150
60
45
255

150 feet

2.81
20
56.20
255

1.7497
1.4065
3.1562

lbs 1430

376
10
20
148
554

21

6.4597
2.7435
2.7435
1.3222
3.2689

2220

5 | 1850
370
2220

185
40
10
235
117

9

6.4597
2.3711
2.3711
0.9542
2.1661

146
3796

Block 10.

$$\begin{array}{r} 3.1278 \\ .0664 \\ \hline 3.1942 \end{array}$$

1560

KA9

Block 11

$$\begin{array}{r} 3.1074 \\ .0664 \\ \hline 3.1738 \end{array}$$

$$\begin{array}{r} 1500 \\ 200 \\ \hline 1700 \end{array}$$

TAE

Block 12

30
19
140
2.0
500
20
108
13

1850
425

6.4597
2.6284

22 2.6284
1.3424

3.0589

200
1140

1340

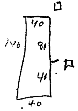
TAE

Block 13

1000	6.4597
40	2.8209
40	2.8209
130	24 1.3802
115	
1325	3.4817
662	

$\boxed{3020}$

Led entirely from one side



30
136
20
300
20
115
166

TAE

Block 13

920 feet

396 feet
2
792

1840
792

105.8
20.

46
1
20

105.8
11.0

105.8
1058
1163.8

20
20
220

1163
220
~~1383~~
943

w = weight of wire
a = Cross section in 0.0001
l = length omt =
r = resistance

W = Wt. of a wire two feet long the cross section of wh. is 0.0001 sq. in.

R = Resistance of wire two feet long with cross section of 0.0001 sq. in.

$w = l\,a\,W$ TAF

$a = \frac{w}{l\,W}$

2000 feet amt wire weighs 500 lbs. and has a cross section of .0324 sq. in.

Cross section of 0.0001 sq. in

500
.0324
lbs 15.1

2.6990
2.5105
.1885
3.3010 in 2000 feet

log W = 6.8875
Comp log W = 3.1125

4941
3203
8144

Around block
1512
3915
2940
8367

Block 1

604
20
20
644 feet

2.8089
2.8089
27 1.4314
7.0492
6.3933
3.4427
.0664
3.5091

2777
3203

3.5091
7.1911
3.1125
.8127

TAE

.6510

3.2773
7.2306
3.1125
3.6204

.4170

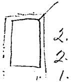
2.7305
7.3696
3.1125
3.2126

.1630

1.5575
7.7520
3.1125
2.4223

.0290

Block 2



2.7694
2.7694
1.2788
6.3933
3.2109
.0664
3.2773

385
30
20
148
10
588

Decreasing

1620

Straight

1890

387
10
30
427

2.6304
2.6304
1.
6.3933
2.6641
.6664
2.7305

TAE

461

537

137
10
30
177

2.2480
2.2480
0.6021
6.3933
1.4914
.0664
5578

31

36

2112 2463

Block 3

514
510
137
20
20

1201

60.0

2.7782
2.7782
30 1.4771 2670 3110
6.3933

3.4268
0664

3.4932
7.2218
3.1125

3.8275 .672

TAE

Block 4

1020
80
20
35
1155
577

2.7612
2.7612
34 1.5315
6.3933
3.4472 2800 3260
.0664
3.5136
7.2368
3.1125
3.8649 .732

TAE

4.4780
2.5611
1.9169
− 82

C = 20
20
264
20
20
364
182
82
.100

6
4

[illegible]

Block 5

$$X = \frac{(b-a)(b+a)Y}{6EC} + \frac{C}{2}$$

a = 472
b = 762
C = 1022
30
1052
526

762
472
290

472
762
1234

TAE

3.0912
2.4624
8.9254
4.4780
3.0220
1.4560

10.52
554
498

526
28
554
498

30
10
400
20
460

Decreasing
Same age

1.4560
.0664
1.3896

24.5

2,9862
7,3098
3,1125
3.4085 .256

3,1632
7.2503
3.1125
3.5260 .336

2,1910
7.5719
3.1125
2.8754 .075

Block 5

30
10
400
20
30
490

14

2.6902
2.6902
1.1761
6.3933
2.9198
.0664
2.9862

831 .969

TAE

1052
490
562

16

2.7497
2.7497
1.2044
6.3933
3.0968
.0664
3.1632

1250 1450

264
66 364
30 96
96 268

25

1,9823
1.9823
0.3979
6.3933
.7558

7.5 10

266

2.4281
2.4281
0.8751
6,3933
2.1246
.0664
2,1910

133. 155
2289. 2584

3.2689
7.256 5
3.112 5
3.6379 .433

2.1197
7.5591
3.1125
2.7913 .069

2.7489
7.3325
3.1125
3.1939 .156

Blocks 64

267
53
214
20
198
25
64
10
33
554
328
82
240
30
276
30
162
25
190
58
46.5

2.7435
2.7435
0.3222 21
6.3933
3.2025 1590 1850
.0664
3.2689

2.4409
2.4409
0.7782
6.3933
2.0533 113 131
.0664
2.1197

2.6675
2.6675
0.9542
6.3933
2.6825 481 561
.0664
2.7489 2184 2542

TAE

3.2699
7.2343
3.1125
3.6167 .414

1.3664
7.7852
3.1125
2.1641 .0145

Block 8

529
34
20
583

110
54
164

2.7657
2.7657
19 1.2788
6 3933
3.2035
.0664
3.2699
2.2148
2.2148
0.4771
6.3933
1.3000
.0664
1.3664

1600 1860
20 22
1620 1882

TAE

2.8746
7.3809
3.1125

3.3680

.233

3.4885
7.1568
3.1125

3.7578

.572

Block 9

376
16
30

416

.15

2.6191
2.6191
1.1761
6.3933

2.8076
.0664

2.8740

642 748

TAE

296
10
20
341
30

697

2.8432
2.8432
1.3424
6.3933

3.4221
.0664

3.4885

2640 3080

3282 3825

3.3762
7.2226
3.1125
3.7113

.514

Block 10

20
30
~~1099~~
549
55
599

2.7774
2.7774
23 1.3617
6.3933
3.3098 2040 2380
.0664
3.3762
7.6383
1.0145

TAE

10.3 lbs per lamp in distributing main
14.3 " per lamp
24.6 lbs per lamp

\$7.28 investment per lamp 100 ohms

\$3.64 for 200 ohm lamp

36400 for 10000 lamps

All round

2112
2287
1722
6121

2830
1090
2745
6665

2.6071
7.4634
3.1125
3.1230 .132

1.3068
.0664
1.3732
7.8152
3.1125
2.3009 .0200

3.0138
.0664
3.0802
7.2628
3.1125 .1
3.4555 .285

2.6829
7.3990
3.1125
2.1944 .156

Block 11

20
193
20
162
395

25966
2.5966
9 0.9542
6.3933
2.5407
.0664
2.6071

347 405

TAE

(492
123
20
10
153

2.1847
2.1847
0.5441
6.3933
1.3068

20.2 25

487
162
325
20
188
13
546

2.7372
2.7372
14 1.1461
6.3933
3.0138

1030 1200

492
123
369
30
399

2.6010
2.6010
10.5 1.0212
6.3933
2.6165
.0664
2.6829

413 882
1810 2112

3.3394
7.1878
3.1125

3.6397

.436

Block 12 & 13

500
24
11.5
1.0

649

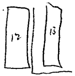
2.8122
2.8122
18) 1.2553
6.3933

3.2730
.0664

3.3394

1875

2180



TAF

3.0333
7.2924
3.1125
3.4382 .274

456 2.6570
7.9031
3.1125
3.6746 .472

Block 13

500
10

2.7076
2.7078
1.0792
6.3933
2.8877
.0792
2.9669
.0664
3.0333

For have to give 2 Values +20% in district

TAE
~~772~~

926 1080

~~125~~
125 feet

456 456
1382 1536

1.9 lbs
20
380
120
760
34
456.0

20

249

2.3962
2.3962
0.7782
6.3933
1.9639

92 110
1474 1646

Block 14

100 2.2095
2.2095
162 .3010
.3010
6.3933

1.5743 32 40

TAE

180 2.2553
2.2553
.3010
.3010
6.3933

1.5059 32 40
10 10

74 90

1/4 Volts

Block 15

$$\begin{array}{r} 268 \\ 20 \\ 10 \\ \hline 298 \end{array} \qquad x = \frac{(b-a)(b+a)\,F}{6\,E\,C} + \frac{c}{2}$$

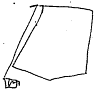
TAE

$$\begin{array}{r} 762 \\ 298 \\ \hline 1066 \end{array} \qquad \begin{array}{r} 762 \\ 298 \\ \hline 464 \end{array} \qquad \begin{array}{r} 2.6665 \\ 3.0253 \\ 89254 \\ \hline 4.6172 \\ .24742 \\ \hline 2.1430 \end{array}$$

$$2\overline{)298}$$
149

139

Feed all



$$\begin{array}{r} 2\ 4742 \\ 2\ 4742 \\ \cancel{0}. \\ 6.3933 \\ \hline 2.3417 \end{array}$$

200 225

$$\begin{array}{r} 243 \\ 10 \\ 20 \\ 10 \\ \hline 283 \end{array} \qquad \begin{array}{r} 2.4518 \\ 2.4518 \\ 1. \\ 6.3933 \\ \cancel{6386} \\ \hline 2.2979 \end{array}$$

$$\begin{array}{r} 198 \\ \hline 398 \end{array}$$ 225

Block 16

200 225

TAE

268
10
278

2.4440
0.4440
.7782
6.3938
2.0595

230
124
354

270
150
420

Block. 17

15
35
220

$$x = \frac{(b-a)(b+a)\,f}{6E.C.} + \frac{C}{2}$$

$b = 831$
$a = 220$
611

831
220
1051

TAE

363
13
-20
268
10
674
337

3.6216
2.7860
8.9254
4.7330
2.8287
1.9043

337
80.2
417

363
33
396

2.5977
2.5977
.7782
6.3933
2.3669
.0664
2.4333

230
270

Block 18

One side

Same as Block 17	230	270
Truss	150	150

TAE

Block 19.

1.0
262
2.0
95
10

397
198

2.2967
2.2967
0.9542
6.3933

1.9409 873

Block 20

.40	2.2765		
298	2.2765		
40	0.9031	TAE	
378	6.3933		
139	1.8494	70	90

40	2.6138		
192	2.6138		
20	1.1461		
320	6.3933		
20	2.7670	588	681
191	.8654		
40	.8337		
1023			
411		658	771

2 | 314
157
-0
167

Block 21

2.04
30

2.3617
2.3617
.60 = 1
.68937
1.7188

THE

	60	80
	90	110
	90	110
Estimated	240	300

Block 22

370	2.3617
35	2.3617
35	1.0792
20	6.3933
$\boxed{460}$	
230	2.1959

TAE

157 180

Block 23

Same as Block 7   230   270

275
36
311

2.4924
2.4928

6.5933
2.3789

240 & 280
470   5-0

THE

1/10

220
370
59
219
164

286
50
20
56
412

2.6149
2.6149
1.0414
6.3733
2.6645 462 550
.0664
2.7309

80

1.9031
1.9031
0.4771
6.3933
6746 10 12

Estimated 50 60
10 12
532 634

Block 24

$$x = \frac{(b-a)(b+a)\,7}{6\,\varepsilon\,c} + \frac{c}{2}$$

b = 1046 1046 1046
a = 364 364 364
b−a = 682 b+a = 1410

3.1492
2.8338
8.9254
4.9104
2.7642
21462
298
140
158

206
50
20
215
10
10
561
1990

215
158
057
10
067

TAE

33
32
285
350

35
63
98

1.9912
1.9912
.3010
6.9933
.6767 1010

428
350
78

378
98
280

33
32
345

2.5378
2.5378
1.0969
6.3913
2.5658 368 429
.0664
2.6322

26

38
282
20
35
426

2.6294
2.6294
1.0792
6.2930
2.7313 538 624
.0664 916 1069
2.7977

Over

$a = 634$
$b = 1046$
1680

$$X = \frac{(b-a)(b+a)\,7}{6\,\Sigma\,C}$$

1046
634
412

3.2253
2.5149
8.9254
4.8656
2.6866
2.1790

TAE

33
32
378
10
33
486
243

33
32
285
428
.20
282
35
1115
557
66
623

151
243
394
65
329

4.8656
3.0472 66
1.8184

712 feet
2630
~~3699~~ lbs

~~.00187~~

63 lbs.

.00115

2630 3.4200
63 1.7993
1.6207

41.8 1.6207
.0057 3.7559
7.3766
~~.273~~ .3010
.238 1.6776

.476

Block 25

916 1069

428
66
342
20
285
22
33
10
712 180

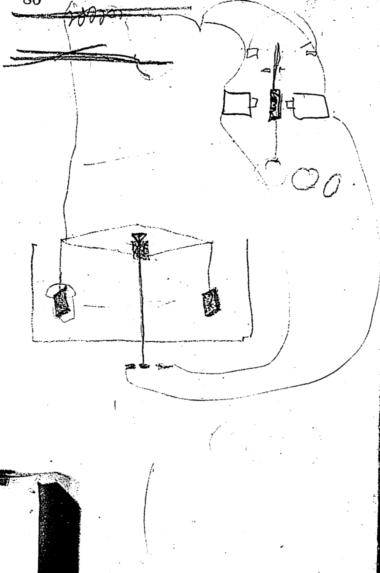
2.8525
2.8525
1.2553
6.3933
3.3536
.0564
3.4200
2.2553
1.1647

2260 2630
3176 3699

THE

(14.5 lbs. per lamp
7.25 per another lamp

3.4200
7.1474
3.1125
3.6799 .478



Block 26

a = 220
b = 364
584

364
220
144

2.1584
2.7664
8.9254
3.8502
2.7427
1.1675

TAE

12

10
193
020
320
10
553
276
12
288
203
85

10
193
20
80
303

2.4814
2.4814
a 8129
b 13933
2.1690

147 170

Ober

Block 26

147 170

320
60
240
10
250

2,3979
2.3979
0.6532
6.3933
1.8423

TAE

70 80
217 250

214
2.3314
2.3314
0.6021
6.3933
1.6582

455 535

307
2.4871
2.4871
1.1461
6.3933
2.5136
.0664
2.5800

Done away with

326 380
588 685

Block 27

20	25
80	95
100	120

.218
37 2.4065
2.4065
55 0.6990
6.3933
1.9058

TAE

Block 28

43		2.7490	
864		2.7490	
10	26	1.4150	
195		6.3933	
10			
1122		3.3063	2020 2360
		.0664	
561		3727	TAE

Block 29

13
20
10
179
20
138
20
87
20
128
10
752
76
33
709

2.6117
2.6117
1.1903
6.3933
2.8070
.0664
2.8734

641 747

THE

200
10
20
230

2.3617
2.3617
.9031
6.3933
2.0198

103 125

20
213
20
112
365

2.5623
2.5623
1.1139
6.3932
2.6318
.0664
2.6982

10 / 113

428 499

112
10
122

2.0864
2.0864
0.6990
6.3933
1.2651

.18 25
659 661

Block 30

$$X = \frac{(b-a)(b+a)7}{6EC} + \frac{c}{2}$$

a = 479
b = 752
1231

752
479
273

TAE

3.0899
2.4362
8.9254
4.4515
2.4683
1.9832

244
10
20
20
294
147
962
508

4.4515
2.8129
1.6386

90.2

435

29
174
20
225
20
213
29
650

Block 31

20 25

124
10
10
10
246
20
84
5.04

2.7024
2.7024
1.0792
64840
6.3933
2.8773
.0664
2.9437

TAE

754 878

232
35
32
299

2.4757
2.4757
9031
6.3933
2.2478
0664
2.3142

177 207
951 1100

Block 32

2.9706
.0664
3.0370

935 1090

TAE

287
57
230
10
18
258

2.4116
2.4116
0.6812
6.3933
1.8977

79 85
2 3

57
28
18
88

1.9294
1.9294
8.0792
6.3933
3.313

135
10
TRR

2.1614
2.1614
8.3979
6.3930
1.1140

13 15

18
97
20
270
10
415

2.6180
2.6180
0.9031
6.3933
2.5324
,0664
2.5988

341 397
435 500

Block 33

$$\lambda = \frac{(b-a)(b+a)\,\gamma}{6\,E\,c} + \frac{c}{2}$$

a = 220
b = 537
757

537
220
317

TAE

2.8791
2.5011
8.9254
4.3056
2.5224
1.8832 76.4

287
10
18
18
333
166
76.4
2424

27
28
219
274

2.4378
2.4378
0.6021
6.3933
1.8710 74 90

27
28
193
20
105
373

2.5717
2.5717
0.6990
6.3933
2.2357
0666
3021

172 210

105
10
115

2.0607
2.0607
.3010
6.3933
.8157

6.5 7.5
2525 29.75

Block 34

$x = (b-a)(b+a)$

a = 537
b = 1051
1588

1051
537
514

TA

3.2010
2.7110
8.9254
4.8374
2.6898
2.1476

27
28
193
20
211
10
489
244
140
104

140

Block 35

167	2.0899
10	2.0899
10	0.6021
30	6.3933
30	
247	1.1752
123	

15 20

TAE

10	2.6749
10	2.6749
30	1.3010
30	6.3933
310	3.0441
20	.0664
186	3.1105
20	
330	
946	
473	

1100 1290

1115

479
29
213
32
753

Block 36

598	2.6031
10	2.6031
156	1.2553
410	6.3933
774	2.8548
387	.0664
14	2.9212
401	

7/15 834

TAE

Blocks 37 & 38

10	2.3579
135	2.3579
24	0.8451
59	6.3933
228	1.9542
	.0664
	2.0206

90 105

TAE

Block 39

200

20 25

2 .3010
2 .3010
0.4771
6.3933

47.24

30 35

50 60

TAE

Block 40

196
20
177
10

100 120

TAEDISON

Block 41

10
15
20
15-8
10
3

73 90

TAEDISON

Block 42

60 75

TAEDISON

Block 43

1792
396
50
456

2.6590
2.6590
1.1761
6.3933
2.8874
.0664
9538

TaE

771 899

30 40

801 939

Block 44

468
50
$\overline{338}$

2.7308
2.7308
1.3424
6.3933
$\overline{3.1973}$
.0664
$\overline{2637}$

1570 1830

TAE

Block 45

20	25
140	170
160	195

Block 46

30
10
227
20
114
401

2.6031
2.6031
0.9542
6.3933
2.5537
.0664
2.6201

357 . 417

40 50
397 457

Tuc

Block 47

192 220

TAE

Block 48

409
30
429

2.6425
2.6425
1.2304
6.3933
2.8087 644 .750
.0664
.8751

215.

2.3324
2.3324
.6021
6.3933
1.6502

45 60
689 810

TAE

Block 49

418
30
448

2.6513
2.6513
1.3010
8.3933
2.9969 993 1150
.0664
3.0633

TAE

Block 50

200 / 240

TAE

Block 51.

490
30
40
560

2.7482
2.7482
1.1461
6.3933

3.0368
.0664
3.1032

1100 1260

TAE

6029
2112

330) 8151

3.9112
2.5185
1.3927

24.7 lbs cu. per 100 Ohm loop

84

52,300

4.7185
.0664
4.7849

61,000
52,300
8,700

61,000 lbs

61,000
88983
149983. lbs to supply Dynalim

	2777	30 —	559
	2112		951
	2670		935
	2800		435
5 —	2289		2525
64	2184	35 —	1115
	1620		716
	3282		90
			50
10 —	2040	40	100
	1810		73
	1875		60
13	1474		801
	74		1570
15 —	398	45 —	160
	200		397
	354		192
	150		689
	873		993
20	658		200
	240		1100
	157		14711
	470		37564
	532		52275
	3176		
	588		
	100		
	2020		
	641		
	37564		

TAE

Station at corner No. 1
to have the conductors brought
a shorter route.

21 Stations now for distribution

~~||||~~ | ~~||||~~ ~~||||~~

16 separate lines

396	220
15	10
268	370
10	58
689	215
	10
	883

396 of 1013 feet
100
10
162
10
20
130
35
140
10
1013
160
853

3429	4971
4191	6039
1587	2287
1397	2013
10604	15116

15116
10604
4512 lbs less
30
$ 1354.60 saved

~~3~~3
90
2970

TAE

4512
1221
5733
~~1729~~

4191
2970
1221 lbs by making new station
30
$ 366.30
1354
2710.30

Lamps

30

200 hours each lamp
for fifty cts

$\frac{200}{8} = 22.2$ hours
for a H. P

22.2) 500 (2.2 cts.
44,4
560

$\frac{200}{8} = 2.5$

~~2.5) 5~~ 2.5) 5.00 (2 cts. an hour

50 cts Lamps

50 cts cost per H
3200 at 9 per H.P

50 cts ~~for~~ cost.
7 per H.P. 12 candles each
600 hours TAE
~~300 hours~~

~~200 hours H. 9 H.~~

7 per H.P. 16 candles each
300 hours

Lamps 85 cts each

~~500~~ ~~600~~ ~~600~~

600
85
30.00

3.000
For lamps $11\frac{2}{3}$ cts per H

Lamps

50 cts for M.

at 8 per H. P.

50 cts for 200 hours
for one burner

50 cts for $\frac{200}{8}$ ~~hours~~ hours
~~hours~~ for one
horse power

50 cts for 25 horse
power for one
hour

2 cts. for 1 horse
power for one
hour

Lamps

2 cts

$7\,\underline{)400}$
57.1

$\frac{2}{7} \times 200 = 57.1$ cts per M
11.66
Total cost = 66.76 cts

$7\,\underline{)400}$
44.4

$\frac{2}{9} \times 200 = 44.4$ cts per M

Lamp cost
11.66
2
23.33 cts

TAE

44.4
23.3
67.7 cts

Lamps

1000 feet

60 lbs per [illegible]

12 cand

$$\begin{array}{r} 2\cancel{5} \\ 60 \\ \hline 1.50 \end{array}$$ per M

TAE

$$\begin{array}{r} 16 \\ 8 \\ \hline \end{array}$$

(84 candles incandescence

7 per H.P 20 lbs. per 1000 candles.

$\frac{2}{7}$ per lamp per hour

$\frac{2}{7} \times \frac{\cancel{1000}^{500}}{\cancel{12}_{63}}$ per 1000 candles

$$\begin{array}{r} 12 \\ 7 \\ \hline 84 \end{array}$$

$$\begin{array}{r} 21\overline{)500}(23.8 \\ 42 \\ \hline 80 \\ 63 \\ \hline 170 \end{array}$$

Lamps

lamp ~~Cast~~ 600 hours
costing 35 cts

$$\frac{600 \times 12}{7200}$$ candles for 35. cts

$$\begin{array}{ll} 3.5. & 1.5441 \\ 7.2 & 0.8573 \\ \hline & 6868 \end{array}$$

4.8 cts

TAE

$$\begin{array}{r} 23.8 \\ 4.8 \\ \hline 28.6 \end{array}$$ Total cost

144 candles incan. 300 Hours Lamps
9 per H.P. of 16 candles

$$\frac{\cancel{2}}{9} \times \frac{\cancel{1000}\ 125}{\cancel{16}\ 8} = 13.9 \text{ cts}$$

$$\begin{array}{r} .16 \\ 9 \\ \hline 144 \end{array}$$

$9 \overline{)125}$
13.9

14.45 ; 17.60 :: 15.79

$$\begin{array}{r} 1.1959 \\ 1.2455 \\ \cancel{8}.8416 \\ \hline 1.2830 \end{array}$$

TAE

19.20

$$\begin{array}{r} 4.8 \\ 2 \\ \hline 9.6 \end{array}$$

$$\text{Total cost} \quad \begin{array}{r} 13.9 \\ 9.6 \\ \hline 23.5 \end{array} \text{ cts}$$

~~10 of 12~~
9 of 12

883
44
290.
10
1221

831
44
112
40
180
10
1217

Station at corner of
Block 24 can be made
883 feet from central
station

Lamps
90
145
65
110
405

1240
1960.
912
1575
5687
3908
1779

96.5
40.5
4825
3860
3908.25

TAE

1779 lbs Cu

from page 135

5773
1779
7552.

149.983
~~7.552~~
142.431
128.506
13.925 lbs more than other system

Length of distributing wire in system where it is run seperately from all other wires.

35,457 feet

TAE

[illegible]

[illegible] 3 [illegible] 4 [illegible]

TAE

Data from which the preceding calculations are made

The lamps are ~~the~~ assumed to have a resistance of 100 Ohms. 30 lamps placed 60' apart on a line 1800 feet long, so that there would be a resistance of 10 Ohms to each lamp if the conductor were made up of separate strands. Both conducting wires together weigh 440.7 pounds, and if at the machine there is 100 Volts tension between the lines there will be 87.6 Volts at the lamp 1800 feet from the machine or a drop of 12.4 Volts.

a

The fall in E. M. F. will be inversely proportional to the amount of copper in the conductor. There will be the same proportional fall for 10 lamps 180' apart as for 30 if there is 1/3 the amount of copper in the conductor.

i.e. $\frac{4407}{3} = \underline{\underline{1469}}$ lbs TAE

The amount of copper required varies as the square of the distance that the lamps are apart. ~~and~~ or as the ~~distan~~ square of the distance of ~~the~~ the furthest removed lamp.

Let a = distance to extreme lamp.

b = number of lamps ÷ 10

C = amount of copper in conductor,

x = Fall E.M.F. on conductor a feet long with b lamps on it, & weighing c pounds.

$1800^2 : a^2 :: 146.9 : d$?

$$d = \frac{146.9\,a^2}{1800^2}$$

d = amount Copper that will give 12.4 Volts fall on a conductor a feet long with 10 lamps

$$12.4 : X :: \frac{c}{b} : d$$

$$X = \frac{12.4\,d\,b}{c} = \frac{12.4 \times 146.9\,a^2 b}{1800^2 c}$$

If instead of 100 Volts to start with there are 110 Volts at the machine then the fall in E. M. F will be $\frac{1}{10}$ greater

$12.4 + 1.24 = 13.64$ Volts

Then $x = \frac{13.64 \times 146.9 a^2 b}{1800^2 c}$

Tif

Let $x = 2.5$ volts it is required to find the value of C for ~~le~~ lamps at a feet from machines

$$X = \frac{13.64 \times 146.9 \times a^2 b}{1800^2 \, C}$$

$$C = \frac{13.64 \times 146.9 \times a^2 b}{1800^2 \times \cancel{x}}$$

$$\frac{13.64 \times 146.9}{1800^2} = .000618$$

$$C = \frac{.000618 \, a^2 b}{2.5}$$

$$C = 0002473 \, a^2 b x$$

	1.1347
	2.1670
	6.7447
	6.7447
	6.7911
2.5	0.3979
	6.3932

$$C = \frac{.000618\, a^2 b}{2.5}$$

$$C = .000247\, a^2 b$$

$$\log .000247 = 6.3932$$

$$\begin{array}{r} 100 \\ 5.24 \\ \hline 94.76 \end{array}$$

I worked this out in another book and am quite sure that it is right
March 22 1881 FRU

Conductor of the same size
for the whole length with ten lamps on it 180 feet apart the total resistance of the conductor being 1 Ohm If at the machine there are 100 Volts at the end of the conductor there will be 94.76 Volts or a fall of 5.24 Volts. If at the machine there is 110 Volts there will be a fall of 5.764 Volts on the line and take 405 lbs of Cu in the line 1800 feet long.

Since the fall is inversely proportional to the amount of copper used in the mains, to compare with the conductor in which there was a fall of 13.64 Volts, there will be n pounds of copper in the uniform sized conductors to give the same fall.

$$5.764 : 13.64 :: n : 405$$

$$n = \frac{405 \times 5.764}{13.64} = 171.2$$

2.6075
0.7607
8.865/2
2.2334

$\log n = 2.2334$
$\log 146.9 = 2.1670$
$.0664$

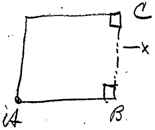
(page 155a)

That is it require 1.165 times as much copper for a straight

conductor as it does for a decreasing conductor to give the same fall of E. M. F.

TaE

To find the best point to run the wires to in feed a distributing wire from both ends



TAE

Let $AC = a$
$AB = b$
$Cx = X$
$CB = C$
$Bx = C - X$

If there are n lamps along the ~~conductor~~ BC

$\frac{X}{C}n$ will be fed from C

$\frac{C-X}{C}n$ " " " " B

Data for $\mathcal{F}$

10 lamps at 10 feet require
.0125 lbs of Cu.

at 1 foot 1 lamp

$$\frac{.0125}{1000} = .0000125$$

Datum for $\mathcal{E}$

16 lamps on 1800 feet require
146.9 lbs of Cu

146.9	2.1670
Comp 10.	9.
Comp 1800	6.7447
comp 1800	6.7447
	4.6564 -10
	1.1347
	9.6021 - 10
	5.3932
	.0664
	5.4596

Let $\mathcal{F}$ = The weight of copper required in the main line to feed a lamp at a distance of one foot.

& $\mathcal{E}$ = The weight of copper required in the distributing wires to feed one lamp at a distance of one foot from distributing point.

$\mathcal{F} = .0000125$ Log $\mathcal{F} = 5.0969$

Decreasing conductor

$\mathcal{E} = 0.00002473$ Log $\mathcal{E} = 5.3932$

Uniform sized conductor

$\mathcal{E} = 0.00002882$ log $\mathcal{E} = 5.4596$

The values of $\mathcal{E}$ can be obtained easily by substituting in the last equation on page 161

$a = 1$

$b = 1/10$

To supply $\frac{X}{C}n$ lamps through A requires

$\frac{X}{C} n a^2 \mathcal{F}$ lbs. in main

$\frac{X}{C} n X^2 \mathcal{E}$ lbs. in distributing

To supply $\frac{C-X}{C} n$ lamps from B requires

$\frac{C-X}{C} n b^2 \mathcal{F}$ lbs. in main

$\frac{C-X}{C} n (a-x)^2 \mathcal{E}$ lbs. in distributing

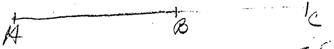
The problem is to make the sum of these weights a minimum

$$\frac{x}{c} n a^2 \mathcal{F} + \frac{x}{c} n x^2 \mathcal{E}$$
$$+ \frac{c-x}{c} n \cdot b^2 \mathcal{F} + \frac{c-x}{c} n (c-x)^2 \mathcal{E} = \text{min}$$

Differentiated making equal to zero multiplying by c and dividing by n we have

$$a^2 \mathcal{F} + 3x^2 \mathcal{E} - b^2 \mathcal{F} - 3(c-x)^2 \mathcal{E} = 0$$
$$\cancel{3x^2} \mathcal{E} - 3c^2 \mathcal{E} + 6cx\mathcal{E} - \cancel{3\mathcal{E}x^2}$$
$$= b^2 \mathcal{F} - a^2 \mathcal{F}$$
$$6c\mathcal{E}x = b^2 \mathcal{F} - a^2 \mathcal{F} + 3c^2 \mathcal{E}$$
$$x = \frac{(b-a)(b+a)\mathcal{F}}{6c\mathcal{E}} + \frac{c}{2}$$

To find the most profitable place to feed a distributing system



AB a uniform wire TAE on which there is a fall of ten Volts. BC an uniform or decreasing wire on which there is a fall of 2.5 Volts

Let $AC = a$

" $AB = X$

" $BC = a - X$

Let $7 =$ Values on ~~t~~ page 173

& $E =$

$$x^2 F + (a-x)^2 \Sigma = \text{min}$$

$$x^2 F + a^2\Sigma - 2ax\Sigma + x^2\Sigma = \text{min}$$

$$F x^2 + a^2\Sigma - 2a\Sigma x + \Sigma x^2 = \text{min}$$

$$2Fx - 2a\Sigma + 2\Sigma x = 0$$

$$(2F + 2\Sigma)x = 2a\Sigma$$

$$x = \frac{a\Sigma}{F+\Sigma}$$ Ta?

$$\frac{\Sigma}{F+\Sigma}$$

247 0.3927 .0000125
3.72 0.5705 .0006247
.8222 .0000372

66.4% for decreasing

125
288
413

$\frac{18}{12}$ $\frac{12}{6}$

35
35
175
105
1225

2

42
42
84
168
1764

2 Ohms

$\frac{176}{122} \times 2$
61 1.76

T

W. water = 0,869 kg ~~grammes~~ Kilogram

20' = time

49°,8 temperature

$$\frac{0,869 \times 49°,8}{20}$$

0,869
49,8
6952
7821
3476
43,2762

2,1638
~~0,0022~~
43,2762
43,2762
~~4,1760~~

4,76
775
2980
3332
3332
36890

775

3689 for pound

33000 | 3689 / 8,9

39000

7,5 | 8,1
7,65 | 8,1

19
2
12)38''
3'.166

~~200~~
~~£~~100
16.

.150
2
300

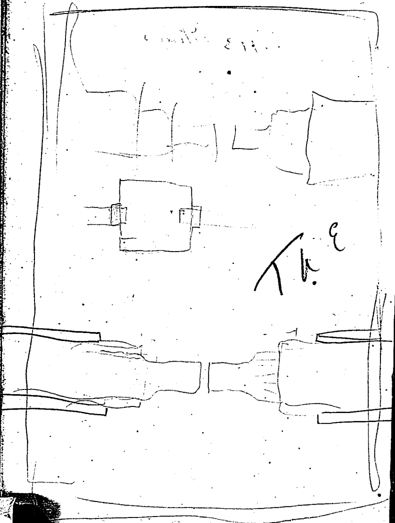
3'.166
15020
158300
3166
475.900

4|475 feet
1.19

175 feet to make Ohm
6
1050
4
4200) 475.0 (11.3/100
4200
550
420
130

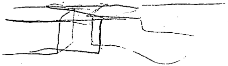
1050

.113 Ohms



Th. E

T69



Menlo Park Notebook #160 [N-80-06-16.2]

This notebook was probably used on September 23 and September 24, 1880 to record tests made by Edison, Francis Upton, Francis Jehl, and Sigmund Bergmann of gas jets at Bergmann's factory. (See Charles P. Mott's entries of those dates in Menlo Park Notebook #117.) Included also are references to books on gas lighting and a clipping relating to gas light tests made by the New York Department of Public Works. The label on the front cover is marked "Gas." The book contains 282 numbered pages. The last page has been torn out of the book.

Blank pages not filmed: 24-195, 198-235, 238-239, 242-253, 260-273.

WEDNESDAY, JUNE 16, 1880.

Official Report of Examinations of Gas for two Weeks ending June 5, 1880, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

May 1880.	Time of Day at which Test were made.	New York Gas-Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
		*	*	†	*	*	†
24	Between	25.65	20.18	26.75	22.30	18.90	29.27
25	9.30 A.M.	24.26	20.26	27.08	22.56	19.28	28.24
26	and	27.61	20.33	25.00	21.82	19.22	28.28
27	1 P.M.	23.41	20.42	25.98	22.01	19.00	26.92
28		24.15	20.14	26.26	21.04	18.06	29.08
29		24.52	20.48	26.32	21.59	18.15	29.15
	Average	24.93	20.29	26.23	21.88	18.77	28.82
31							
June 1		23.31	20.44	25.96	21.24	18.43	29.12
2		19.05	20.36	25.62	21.12	17.96	29.18
3		20.38	19.82	25.08	21.73	17.62	28.72
4		21.84	19.95	25.27	21.65	18.51	28.55
5		24.88	19.84	24.54	22.82	17.90	28.49
	Average	21.89	20.08	25.29	21.71	18.08	28.80

* Five foot lava tip with check.
† Bray's slit union, No. 7.

E. G. LOVE, Gas Examiner.

THIS forenoon, as one of the employees of the

Goodwin Meter Co 142 Chambers
Pholometers, Pressure Guages etc

American Meter Co 512 W 22nd

Kings Treatise on Coal gas $10.
A M Callender & Co 42 Pine

Ask Price Amn Gas Ljnl from
Commencement to date, 32 Vols —

WEDNESDAY, JUNE 16, 1880.

Official Report of Examinations of Gas for two Weeks ending June 5, 1880, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

May	Time of Day at which…	…rk …ight Co.	…ian …ight Co.	…ight Co.	…litan …ight Co.	…ight Co.	…al …ight Co.
5		24.88	19.84	24.54	22.82	17.90	28.49
	Average	21.89	20.08	25.29	21.71	18.08	28.80

* Five foot lava tip with check.
† Bray's slit union, No. 7.

E. G. Love, Gas Examiner.

This forenoon … as one of the employees of the

Goodwin Meter Co 142 Chambers
Photometers, Pressure Guages etc

American Meter Co 512 W 22nd St NY

Gas and Water Co Directory [illegible]
London - Orders recd Am Gas L. Journal

Cathels, Gas consumers [illegible]
42 Pine st Room 18. [illegible] Gas Light Journal
A.M. Callender & Co

Fordell's System Gas Book[illegible]
$5 = See if we haven't got it

Kings Treatise on Coal gas $10.
A M Callender & Co 42 Pine

Ask Price Am Gas L Jnl from
Commencement to date, 32 Vols —

18/10

730 ½ line
Read 1 foot

732. 45 sec
Read 5 feet.

5 on	16	9
8	15 7/8	10
9	15 1/2	
10		
12	15	
14	14/10	
15		
16		
17		
18		
19		
20	13/10	
21		
22		
23		
24	12/10	
25		
26		
27		
28		
29		
30	11/10	

At Bergmans. 4th story 50 feet.
pressure measured with a pressure
U shaped bought at Goodwins was.
19/10 this = =

Upton turned off slightly at meter
gauge 14/10 very noticable diminuation
in size of jet and light, latter very
considerable = 5 lights were on
we noticed that all jets were set
vibrating about 300 per min. —
Could hear no sounds. —

Bergman put on grandually light
by light (5 on) up to 30. when 5 were
on the pressure was 18/10 - when 12
Extra added 15½/10 14 on 14/10
20 added 13/10 — 24 added 12/10
30 added 11/10. This made no
change in first jest except to reduce
its size and amount of light

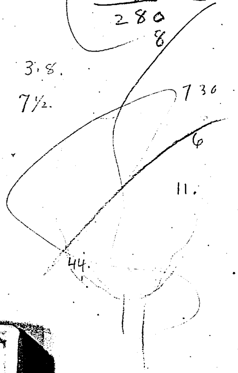
$\frac{60}{11} \times 25$

$$\begin{array}{r} 60 \\ 11)\overline{1500} \\ 36)\overline{136} \\ 108 \\ \hline 280 \\ 8 \end{array}$$

~~3~~ 3.8

3.8.

7½.



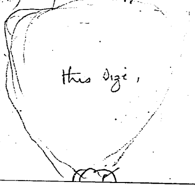
36 Lights on Upton reads
Gas Cos Meter =

7 30½ pm.	Meter reads	1 foot.
7.32. 45 sec.	Reads	6 feet
7.34 . 55 -	"	11 feet.
7.37 .5		16 "
7 39 .20		21 "
7 ~~4~~1 .30		26 "
7 43 45.		31.

~~[illegible]~~

25 feet 11 minutes. in 36 burners, - or 3.8 per burner per hour on testing photometrically we find that the average jet each all on 10 36, gave 7½ candles, size of jet

This was not steady from high pressure but apparently at the best point for greatest light,



pm —

8.29. 30 — our Meter reads 1/2 foot

8.34. 6-Brays special Lavatip " 1 "

8.43. " 2 "

8 59. 45 " 4

— First test 16 candles —

2 15 @ 16.

9.17 — 6

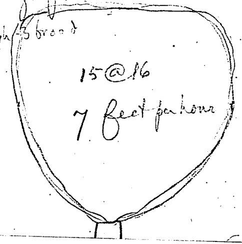
9.30 $7\frac{1}{2}$

Pressure ~~[illegible]~~ at meter at 838,

20/10 — ditto 917 —

Size flame

3 high - 3 broad



2

9

30000

150

1 1/2

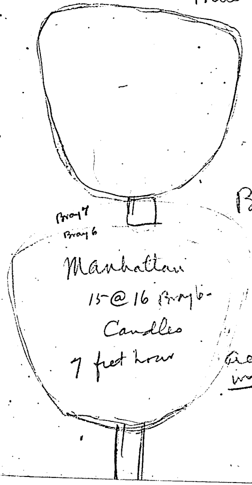
5

7 1/2

7

Frances Sends a wire to pass over Edges flame

thus.



1st trial with wire

Brays

2nd & more ~~accurate trial~~ with wire

8 lbs 1000.
7000

150

22 66 550 - 6

6

21 $2\frac{1}{2}$
21 5
21 $7\frac{1}{2}$ 3
63.

Pressure at 932 - 20/10
1010 same -
1040 19/20

Measurement with Brays
Slit-union No 7 -

9.40. Meter reads $\frac{1}{2}$
952 30 " 2

23 Candles - 1st test -

10.01. 3.
1010 4.+

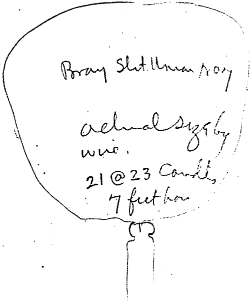
21@22 2nd test, candles

1026. 6.

23@24 3rd test

1040 - $7\frac{1}{2}$

just 7 feet


Bray Slit Union No 7
actual size by wire.
21 @ 23 Candles,
7 feet hour

7 1/2
6 1/2
6 1/2
19 1
19

19 13 1
2
19 1 26 4
52

9 3 1/3

7 min 1/2
1
14 2 7
4
28 1
56

9
12 3
34 4 1/2 16
9 2
13 1/2

Bergmans ~~Lamp~~ Brass 2 hold burner been working 4 months - Same one that gave 7 candles when 36 lights on & 11/10 pressure now have 19/10 pressure - @ 17/10

1048. Zero

~~8~~ 7 @ 8. Candles -

1055 1/2 foot
1101 1

8 @ 9 Candles - pressure 17/10 2nd test.

1107. 1 1/2

7 @ 8 Candles

1126 ~~2 1/2~~ 3

8 @ 9. candles with opal 3 candles

(Pressure . 16 3/4/10

1139. 4 feet
1148. pressure 16/10. 4 6/10 feet

24

5

12

110

8

Brays Union Slit No 7.

Made it. 15 candles,

Pressure – 15/10.

1210 Reads –	3/4 foot
1218	$1\frac{1}{2}$
1223.	2
$1229\frac{1}{2}$	$2\frac{1}{2}$
1235	3.
$1240\frac{1}{2}$	$3\frac{1}{2}$

2nd test 22 candles. [illegible]

1252	$4\frac{1}{2}$

3rd test 15 candles.

109 am – 6 ~~ft~~ feet

2 7/8.

5/

4) 44
11.

3 1/4.

1

4. 44/4
7) 176
25

27 8

5 .30 sec 1/2

23.

28.

1/4

1/4 .4.

7.

13 1

Suggs London Argand · Standard
up as high as it will go without smoking
Reaches nearly to top

am

1.39 - 30 Reads 1/2

1st test 18@19 - Cand Pow

1

145.

149 1/2 1 1/2

6 feet per hour

We now put it down to what
the public would use it.

Measures 14 Candles

1.55.30 -	Zero
202	1/2
208.30	1

72

111111

11

23

5

16

1 1/2

4

210 am Pressure 15/10

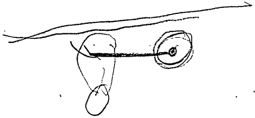
~~Lighted 36 jets and standard~~
~~Sugg Argand fell to~~

Bergman's new Lava tip burner
just bought

231	30	— Reads	1/2
237	15		1
		12 @ 13 Candle	1 1/2
242	15		2
247	45		
254	30		2 1/2

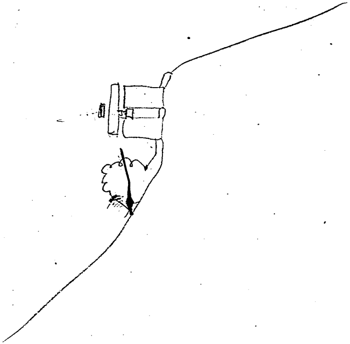
With Opal Globe – 2 candles
without 12 @ 13.

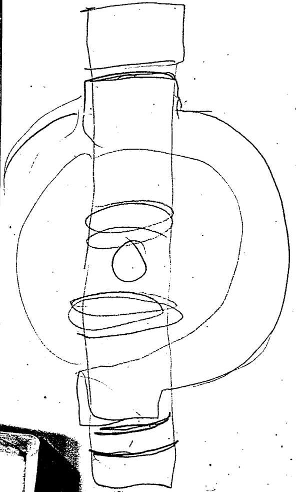
probably 4 candles as it
throws some [illegible]



$S = V$

$S = \left(v + \frac{1}{2} ft\right) t$

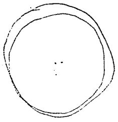




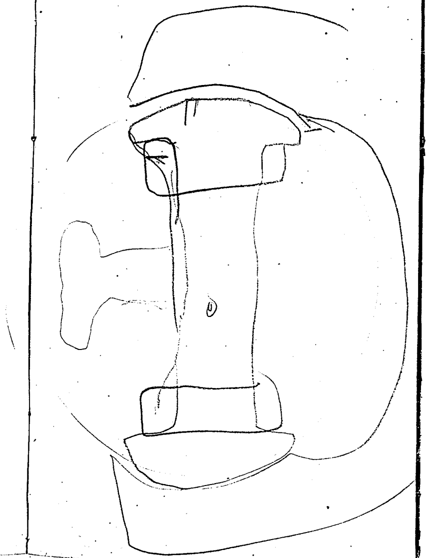
21.

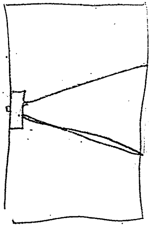
$4\frac{1}{2}$

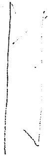
45



18







$$\frac{\begin{array}{r}1000\\33\end{array}}{967}$$

967 : 33 :: x .0187

$$\frac{\begin{array}{r}.0187\\.0967\end{array}}{1309}$$

33)18.0829(.57

$$\frac{967}{33} = \frac{x}{.0187}$$

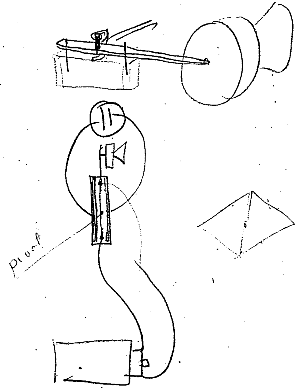
967 × .0187 = 334

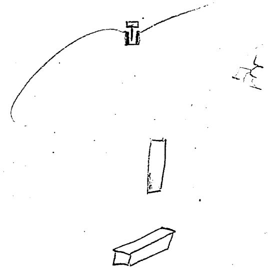
$$\frac{\begin{array}{r}1000\\357\end{array}}{643}$$

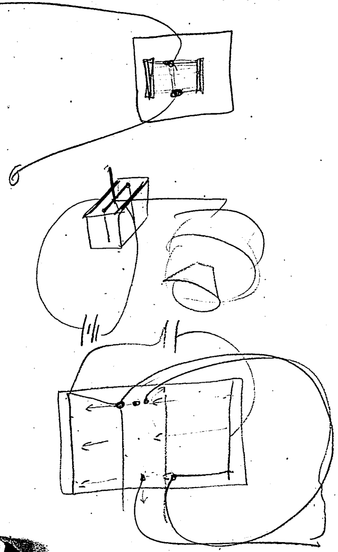
643 : 357 : x : .0187

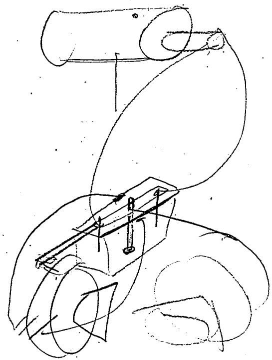
$$\frac{\begin{array}{r}.0187\\643\end{array}}{561}$$

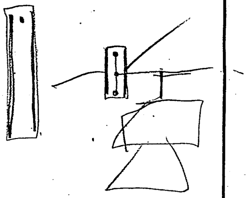
357)1.21241(.03

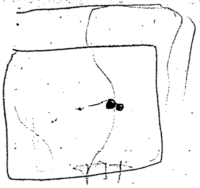












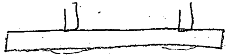
8 | 400,000 000

50.0000

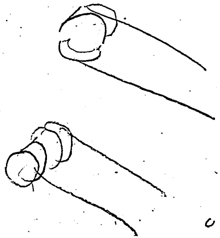
100000.

4

1 40



5



0 | 0

Menlo Park Notebook #161 [N-81-10-18] (NOT FILMED)

This notebook covers the period October 1881-January 1882. It contains what appears to be an inventory of fibers used for the production of carbon filament lamps at the lamp factory. There are also records of other supplies used for the production of lamps. The label on the front cover is marked "Alex Welsh." The book contains 284 numbered pages. Approximately 15 percent of the pages have been used.

Menlo Park Notebook #165 [N-81-00-01]

This notebook is undated but was probably used in 1880. The entries are by Francis Upton and William J. Hammer. Included are notes, calculations, and tables relating to conductors needed for the Pearl Street central station. There are also a few drawings of electric power distribution systems. The label on the front cover is marked "Hammer," "Upton," and "Line Figureing for Station." The book contains 284 numbered pages.

Blank pages not filmed: 234-283.

Square No. 1 Block

2/270
135 Lights

2/1199
599 600 feet

.0049
1.35
.0245
.147
.49
.6615

11.2
135
560
336
112
1512.0

1530
10/270
27 Lights

.0124
.27
868
248
.3338
cross section

145
27
1015
290
3915 weight

1320
10/270
27 Lights
361000

.0106
27
742
212
.2862
c.s.

108.9
27
7623
2178
2940.3 weight

1092 546.

2 | 333 Lights 166.5

.0044 × 166.5 = 220, 264, 264, 44 = .7326 0

9.11 × 166.5 = 4555, 5466, 5466, 911 = 1516.815

1840 +

10 | 333 33.3

.0108 × 33.3 = 324, 324, 324 = .35964

112.2 × 33.3 = 3366, 3366, 3366 = 3736.26

1204.2 -

10 | 333 33.3

.0097 × 33.3 = 291, 291, 291 = .22301

90. × 33.3 = 2997.0

1141 570

2 | 300 Lights 150

.0045 × 150 = 02250, 45 = .6750

9.8 × 150 = 490.0, 98 = 1470.0 lbs

1170 +

10 | 300 30 Lights.

.0094 × 30 = .2820

85.6 × 30 = 2568.0

1030 -

10 | 300 30 Lights.

.0083 × 30 = .2490

66. × 30 = 1980.

1090
545

2 | 340
170

.0044
170
3080
44
.7480

9.11
170
63770
911
1548.70 lb.

1000 +

13 | 340
34 Lights

.0081
34
.2754

62.5
34
2500
1875
212550

920 —

10 | 340
34

.0074
34
296
222
0.2516

52.9
34
2116
1587
1798.6

1266
633

400
200 Lights

.0052
200
1.0400

12.8
200
2560.0

860 +

10 | 400
40 Lights

.0069
40
.2760

46.2
40
1848.0

990 —

10 | 400
40

.0080
40
.0320

61.5
40
2460.0

987
493 feet

2 | 250 Lights
125

125
.0041
125
500
.5125

125
7.81
125
1000
875
976.25 lb

1050 +

10 | 250 Lights
25

.0085
25
425
170
.2125

68.9
25
3445
1378
1722.5

1870 –

10 | 250 Lights
25

.0070
25
.1750

47.3
25
236.5
946
1182.5

2 | 894
447 feet

2 | 160 Lights
80

Source

.0036 sq. in
80
0.2880 sq. in

6.050 lb
80
484.000 lb

740 +

10 | 160
16

.0060
16
.0960

34.2
16
205.2
342
547.2

690 –

10 | 160
16

.0056
16
.0896

29.7
16
178.2
297
475.2

2 / 1027 = 513.5

2 / 220 Lights = 110

.0042 × 110 = .0420

8.45 × 110 = 929.50

1500+

10 / 220 = 22 Lights

.0121
22
242
242
.2662

140.6
22
2812
2812
3093.2

1210−

10 / 220 = 22 Lights

.0098
22
196
196
.2156

91.5
22
1830
1830
2013.0

2 / 1238 = 619

2 / 460 Lights = 230

.0050
230
1500
100
1.1500

120
230
27600.0

1250.+

10 / 460 = 46 Lights

.0101
46
.4646

97.6
46
5856
3804
4389.6

1410−

10 / 460 = 46 Lights

.0114
46
684
456
.5244

124.2
46
7452
4968
4713.2

2 | 230
115 Lights

2 | 1059
529.5

```
 .0042      8.45
   115       115
   210      4225
  42        845
 42        845
 .4830     971.75
```

1430 +   10 | 230
23

```
 .0118     133.2
    23        23
  .354      3996
 236       2664
 .2714     2063.6
```

1620 −   10 | 230
23

```
 .0131     164
    23      23
   393     492
  262     328
 .3013    3772
```

2 | 1400
700

2 | 370
185 Lights


```
 .0057      15.3
   185       185
 .0285       765
 456       1224
 57        153
 1.0545    2830.5
```

1190 +   10 | 370
37 Lights

```
 .0096      88.4
    37        37
 .3552      6188
           2652
           3270.8
```

1090 −   10 | 370 Lights
37

```
 .0088      742
    37       37
   616     5194
  254     2226
 .3136    27454
```

2)360 Lights
180

2)1282
641

.0052
.180
4160
52
.9360

12.8
.180
10240
128
2304.0

900 +

.0079
.36
.2844

10.36
36

60
.36
21.6

880 —

.0071
.36
.2556

10'360 Lights
.36 Lights

48.4
.36
2904
1452
174.24

2)320 Lights
160

2)1283
641.5
320
961

.0052
160
3120
52
.8320

12.8
160
7680
128
1048.0

840 +

101320
32

.0068
32
.2176

44.
32
143

420.—

10
32

.0034
32
.1088

11.0
32
.352.0

2 | 150 Lights
25

2 | 452
226.

.0018	3.025
25	25
90	15125
36	6050
.0450	75.625

620+   10 | 150
25

1.00	24.0
5	5
.0250	120.

600−   10 | 150
.5

.0051	24.8
5	5
.0255	124.0

2 | 320 Lights
160

2 | 924
462

.0037	6.612
160	160
02220	396720
37	6612
.5920	1057.920

490+   10 | 320 Lights
32

.0039	15
32	32
78	1880.
117	
.1248	

230−   10 | 320
32

.0018	3.306
32	32
.0576	6612
	9918
	105.792

2)110 Lights
53

2)760
380

.0031
55
155
155
.1705

4.512
55
22560
22560
248.160

500 +

10)110
11 Lights

.0040
11
.0440

15.6
11
172.6

270-

10)110
11

0022
11
.0232

4.55
11
60.05

2)280 Lights
140

2)1247
623.5

.0050
140
.7000

12.0
140
1680.0

650 +

10)280
28

.0052
28
.1456

26.4
28
2112
528
739.2

430-

10)280
28 Lights

.0033
28
.0900

115.5
28
9240
2310
323.40

$2\overline{)80}$ Lights
40

$2\overline{)788}$
.394

.0031 × 40 = .1240

4.512 × 40 = 180.480

800+

.0065

.0520

45

920

920–

$1\overline{)8}$
8

.0074 × 8 = .0592

529 × 8 = 4232

$2\overline{)210}$ Lights
105

$2\overline{)867}$
433.5

.0036 × 105:
.0180
.36
.3780

6.050 × 105:
30250
6050
635.250

960+

$10\overline{)210}$ Lights
21

.0078 × 21 = .1638

57.6 × 21:
576
1152
1209.6

1070–

$10\overline{)210}$ Lights
21

.0086 × 21:
86
172
.1806

71.1 × 21:
711
1422
1493.1

2|220 Lights
110

2|1041
520.5

.0042
110
.4620

8.45
110
929.50

1120 +

10|220
22

[illegible]
22
[illegible]
.1780

78.4
22
156.8
156.8
1724.8

1220 –

10|220
22

.0098
22
.2156

94.6
22
189 2
1892
2081.2

2|260 Lights
130

2|1030
515

.0042
130
1260
42
.5460

8.45
130
2535 0
845
1098.50

290 +

10|260
26

.0023
26
.0598

5.25
26
3150
1050
136.50

300 –

10|260
26

.0024
26
.0724

5.6
26
145.6

2|140 Lights
70

2|951
475.5

.0139
70
.2730

7.2
70
504.0

10|140
14 Lights

10|140
14

2|1175
587.5

2|260 Lights
130

.0047
130
1410
47
.6110

10.5
130
3150
105
1365.0

180+

10|260
26

.0014
26
84
28
.0364

20.25
26
12150
4050
42650

560−

10|260
26

.0045
26
.1170

19.6
26
1176
392
509.6

2/300 Lights
150

2/1129
564.5

.0045
150
.6750

9.8
150
1470.0

11/300
30 Lights

.0050
30
.1500

30

170

10/300
30 Lights

.0070
30
.2100

47.3
30
1419.0

2/450
225

2/1413
706.5

.0057
225
285
114
114
1.2825

15.3
225
765
306
306
3442.5

730 +

10/450
45 Lights

.0075
45
375
300
.3375

54
45
2430.

1040 –

10/450
45 Lights

.0100
45
.4500

96.1
45
4805
3844
4324.5

2 | 290 Lights.
145

2 | 1054
527

.0042 × 145 = 210, 168, 42 = .6090

8.45 × 145 = 4225, 3380, 845 = 1225.25

200 +   10 | 290
29

.0046 × 29 = .0964 [illegible]

25.00 × 29 = 22500, 5000 = 725.00 [illegible]

870 −   10 | 290
29

.0031 × 29 = 279, 31 = .0589 [illegible]

9.5 × 29 = 855, 190 = 275.5

2 | 210 Lights.
105

2 | 880
440

.0036 × 105 = 205, 41 = .4305

6050 × 105 = 30250, 6050 = 635250

~~7812~~ × 105 = 39060, 7812 = 820.260

520 +   10 | 210.
21

.0042 × 21 = .0882

16.9 × 21 = 169, 338 = 354.9

690 −   10 | 210
21

.0056 × 21 = .1176

29.7 × 21 = 297, 594 = 623.7

2 | 260
130 Lights

2 | 1039
519.5

.0042
130
1260
42
.5460

8.45
130
25350
845
1098.50

1304 [illegible]

[illegible]
26

.0057
26
[illegible] 2

43.05
26
25830
8[illegible]
1119.30

1520 [illegible]

10 | 260
26

[illegible]
26
.049[illegible]
[illegible]
[illegible]

65[illegible]
26
3912
1304
1695.2

2 | 155
77.5 Lights.

2 | 712
356

.0029
77.5
145
203
203
.22475

4.05
77.5
2025
2835
2835
313.875

1550 [illegible]

10 | 155
15.5

.0085
15.5
425
425
85
.13175

35.9
[illegible]
[illegible]

880 [illegible]

10 | 155
15.5

.0071
15.5
355
355
71
.11005

48.4
15.5
2420
2420
484
750.20

2/320 160 Lights

2/896
448

.0036
160
.5760

6.05
160
968.00

2/160 80 Lights

2/690
345

.0028
80
.2240

3.612
80
288.960

580 +

10/160
16

.0047
16
282
47
.0752

.210
16
1260
210
3360

500 -

10/160
16

.0040
16
.0640

15.6
16
936
156
249.6

2/160 80 Lights.

2/923 461.5

.0037 × 80 = .2960

6.612 × 80 = 528.960

4704

.0038 × 15 = .0660 [illegible]

13.8 × 16 = [illegible]

[illegible]

16 [illegible]

.00[illegible] × 16 = [illegible]

12.1 × 16 = [illegible]

2/150 75 Lights.

2/849 424.5

.0034 × 75 = .2550

5.512 × 75

27560

38584

413.400

3604

1/150 15 Lights

.0029 × 15 = .0435

8.1 × 15

405

81

121.5

610

15 Lights.

.0049 × 15 = .0735

23.2 × 15

1160

232

348.0

2|830
415

2|150
75 Lights.

.0034
75
.2550

5.512
75
27560
38584
413.400

710 +

10|150
[illegible] Lights

.0057
15
.0855

21.[illegible]
15
[illegible]75
[illegible]
[illegible]

920 -

.15 Lights

.0074
15
370
74
.1110

52.9
15
2645
529
793.5

2|240
120 Lights.

2|1033
516.5

.0042
120
.5040

8.45
120
1014.00

960 +

10|240
24 Lights

.0078
24
312
156
.1872

57.6
24
2304
1152
1382.4

1280 -

24 Lights.

.0103
24
412
206
.2472

102.4
24
4096
2048
2457.6

2/734
367

2/180
90 Lights

.0029, 4.05
90 90
.2610 364.50

.2272
784
1417.2

2/90
45 Lights

/461
230.5

.0019 1.800
45 45
.0955 81.000

1100+

10/90
9 Lights

.0089
9
.0801

75.6
9
680.4

1040.

10/90
9

.0084
9
.0756

67.6
9
608.4

2/160
80

2/617
308.5

.0024
80
.1920

2.812
80
224,960

1220 +

10/150
15 Right

.0086
15
.129

65.1
16.
206
651
1041.6

16.

.0071
16
.1136

2904
484
[illegible]

2/90
45

2/519
259.5

.0021
45
.0945

2.112
45
10560
8448
95,040

820 +

10/90
9

.0051
9
.0459

42.
9
378

640. –

9 Right

.0052
9.
.0468

.256
9
230.4

2 | 765
3,82.5

2 | 90 Lights
45

.0031
45
.1395

4.512
45
22560
18048
203,040

9 Lights

.0396

2 | 780
390

2 | 150
75 Lights.

.0031
75
.2325

4.512
75
22560
31584
338,400

10 | 150
15 Lights,

.0690

15
.1815

3045

790

10 | 150
15 Lights,

15
.0960

39
15
195
39
585.

2/1120 = 60 Lights

2/710 = 355

.0029 × 60 = .1740

4.050 × 60 = 243.000

10/12[illegible] = 12[illegible]

007.

[illegible]

[illegible].2

[illegible]

[illegible]

× 12

.1[illegible]

11.1

× 12

85[illegible].2

2/921 = 460.5

2/180 = 90 Lights

.0037 × 90 = .3330.

6.612 × 90 = 595,08.0

1130 [illegible]

14 [illegible]

.0091

× 18

728

91

.1638

[illegible]

× 18

[illegible]6

[illegible]

1434.5

1430.

18 Lights

.0115

× 18

.0920

115

.2070

127.3

× 18

10184

1273

2291.4

2/220 Lights
110

2/864.
432.

.0036 × 110 = .3960

6.050 × 110 = 665.500

2/90 Lights
45

2/592
296

.0024 × 45 = .1080

2.812
45
14060
11248
126.540

1326+

10/90
9 Lights

1260-

9 Lights

.0102 × 9 = .0918

99.2 × 9

$2\,\underline{)727}$
363.5

$2\,\underline{)120}$
60 Lights

$$\begin{array}{r} .0029 \\ 60 \\ \hline .1740 \end{array} \qquad \begin{array}{r} 4.050 \\ 60 \\ \hline 243.000 \end{array}$$

1240+

$10\,\underline{)120}$
12 Lights.

$$\begin{array}{r} .0100 \\ 12 \\ \hline .1200 \end{array} \qquad \begin{array}{r} 96.1 \\ 12 \\ \hline 1153.2 \end{array}$$

1120-

12 Lights.

$$\begin{array}{r} [illegible] \\ 12 \\ \hline .[illegible] \end{array} \qquad \begin{array}{r} [illegible] \\ 12 \\ \hline .9[illegible].8 \end{array}$$

$2\,\underline{)595}$
297.5

$2\,\underline{)80}$
40 Lights.

$$\begin{array}{r} .0024 \\ 40 \\ \hline .0960 \end{array} \qquad \begin{array}{r} 2.812 \\ 40 \\ \hline 112480 \end{array}$$

1010+

$10\,\underline{)80}$
8 Lights.

×

$$\begin{array}{r} .0084 \\ 8 \\ \hline \cancel{.0756} \\ .0672 \end{array} \qquad \begin{array}{r} 67.6 \\ 8 \\ \hline \cancel{[illegible]} \\ 540.8 \end{array}$$

990-

8 Lights.

$$\begin{array}{r} .0080 \\ 8 \\ \hline .0640 \end{array} \qquad \begin{array}{r} 61.5 \\ 8 \\ \hline 492.0 \end{array}$$

2/230
125 Lights.

2/876
438

```
.0036        6.050
  125          125
 180         30250
 72         12100
36          6050
.4500       756.250
```

1100 +

Lights.

.2367

1758.5

220 —

23

```
.0074
   23
```

1216.7

2/200
100 Lights

2/797
398.5

```
.0032      5.
  100      100
.3200     500.
```

790 +

10/200
20 Lights

.0064

.1280

784.

1040 —

20 Lights

```
.0084      67.6
   20         20
.1680     1352.0
```

2/872
436

2/150
75

.0036
75
.2700

6.050
75
30250
42350
453.750

1180 +

11/1350
15 Lifts.

.0075
15
.1125

87
15
1305

1370 -

15 Lifts.

.0111
15
555
111
.1665

117.3
15
5865
1173
1759.5

2/911
450.5

2/140
70

.0037
70
.2590

6.612
70
462.840

1440 +

11/140
14 Lifts.

.0116
14
464
116
.1624

129.6
14
5184
1296
1814.4

1690 -

14 Lifts.

.0137
14
548
137
.1918

178.5
14
7140
1785
2499.0

No · No wire
1

2

No of Block	No of Lamps	Length of Distributing Wire	Cross section of Dist. Wire	Weight in lbs of Dist. Wire	Length of the "+" main Wire	Cross section "+" of main wire	Weight of "+" main wire	Length of "-" main wire	Cross section of "-" main wire	Weight of "-" main wire
1	270	1199	.6613	1512.	1530.	.3338	3915.	1320.	.2862	2940.3
2	333	1092	7x326	1516.81	1340.	.35964	3730.20	1204.2	.22301	2997.0
3	300	1143	.6750	1470.	1170.	.2820	2568.	1030.	.2490	1980.
4	340	1090	.7480	1548.7	1000.	.2754	2125.	920.	.2516	1798.6
5	400	1266	1.040	2560.0	860.	.2760	1848.	990.	.0320	2460.
6	250	987	.5125	976.25	1050.	.2125	1722.5	1870.	.1750	1182.5
7	160	894	.2880	484.0	740.	.0960	547.2	690.	.0896	475.2
8	220	1027	.4420	929.5	1500.	.2662	3093.2	1210.	.2156	2013.
9	460	1238	1.150	2760.	1250.	.4646	4389.6	1410.	.5244	4713.2
10	230	1059	.4830	971.75	1460.	.2714	2063.4	1620.	.3013	3772.
11	370	1400	1.0545	2830.5	1192.	.3532	3270.8	1090.	.3156	2745.4
12	360	1282	.9360	2304.	980.	.2844	2160.	880.	.2556	1742.2
13	320	1283	.8320	1048.	540.	.2176	1408.	420.	.1088	352.0
14	50	45.2	.0450	75.125	620.	.0250	120.	630.	.0255	124.
103	4063		1.57935	20966.605	15530	3.71974	37891.96	15284.2	3.06221	29293.6

No. of Block	No. of Lamps	Length of Distributing Wire	Cross Section of Dist. Wire	Weight of Distributing Wire	Length of the "+" main wire	Cross Section "+" main wire	Weight of "+" main wire	Length of "−" main wire	Cross Section of "−" main wire	Weight of "−" main wire		
15	320	924	.5920	1057.92	490	.1248	1880	230.	.0576	1057.92		
16	110	760	.1705	248.16	500	.0440	172.6	270.	.0232	60.05		
17	280	1247	.7000	1680.	650	.1456	739.2	430.	.0900	323.4		
18	80	788	.1240	180.48	800	.0520	320.	920.	.0592	336.		
19	210	867	.3780	635.25	960	.1638	1209.6	1070.	.1806	1493.1		
20	220	1041	.4620	929.50	1120	.1980	1724.8	1230.	.2156	2081.2		
21	260	1031	.5460	1098.5	290	.0598	136.5	300.	.0724	145.6		
22	140	951	.2730	504.			V					central station block
23	260	1175	.6110	1365.	180	.0364	42.65	560.	.1170	509.6		
24	300	1129	.6750	1470.	620	.1500	720.	870.	.2100	1419.		
25	450	1413	1.2825	3442.5	930	.3375	2430.	1240	.4500	4324.5		
26	290	1054	.6090	1225.25	200	.0464	72.50	390.	.0589	275.5		
27	210	880	.4300	635.25	520	.0882	354.0	690.	.1176	623.7		
273	3130		6.6535	14570.81	7260	1.1463	9810.3	8200	1.6840	11578.442		

No of Block	No of Lamp	Length of Distributing Wire	Cross Section of Dist. Wire	Weight of Dist. Wire	Length of the "+" main Wire	Cross Section "+" main Wire	Weight of "+" main Wire	Length of "-" main Wire	Cross Section of "-" main Wire	Weight of "-" main Wire
28	260	1039	.5460	1098.5	830.	.1742	1119.3	1020	.2132	1695.2
29	155	712	.22475	313.87	1050.	.13175	1067.95	880	.11005	750.2
30	320	896	.576	96.80	860.	.2208	1478.4	640	.1664	819.2
31	160	696	.224	288.96	580.	.0752	336.	500	.0640	249.6
32	160	923	.2960	528.96	470.	.0608	.2208	440	.0560	193.6
33	150	849	.2550	413.40	360.	.0435	121.5	610	.0735	348.
34	150	830	.2550	413.40	710.	.0855	472.5	920	.1110	793.5
35	240	1033	.5040	1014.	960.	.1872	1382.4	1280	.2472	2457.6
36	180	734	.2610	364.5	1310.	.1908	1935.0	1120	.1620	1411.2
37	90	461	.0955	81.	1100.	.0801	680.4	1040	.0756	608.4
38	160	617	.1920	224.96	1020.	.1296	1041.6	880	.1136	774.4
39	90	519	.0945	95.04	820.	.0604	378.	640	.0468	230.4
402	2115		352875	4933.295	10070.	143985	1023355	9970.	133575	10331.3

793.5
521.9
1406

4

No of Block	No of Lamp	Length of Distributing Wire	Cross section of Distributing Wire	Weight of Dist. Wire	Length of "+" main Wire	Cross Section "+" main Wire	Weight of "+" main Wire	Length of "–" main Wire	Cross section "–" main Wire	Weight of "–" main Wire		
40	90	765	.1395	203.04	720	.0522	291.6	550	.0396	170.1		
41	150	780	.2325	338.4	570	.0690	304.5	790	.0960	585.		11078 Lamps
42	120	710	.1740	243.	960	.0936	691.2	1070	.1032	853.2		
43	180	921	.3330	595.08	1130	.1638	1434.6	1430	.2070	2291.4		Cross section of Dist. wire 29.12275
44	220	864	.3960	665.5	1530	.2728	3212	1340	.2376	2468.4		Weight of Dist. Wire 48950.005
45	90.	592	.1080	126.54	1320	.0954	980.1	1260	.0918	892.8		Length of + main wire 43880
46	120	727	.1740	243.	1240	.1200	1153.2	1120	.1080	940.8		Cross section of + main 8.18609
47	80	595	.0960	112.48	1040	.0672	540.8	990	.0640	492.0		Weight of + main 75287.21
48	230	876	.4500	726.25	1100	.2067	1738.8	920	.1702	1216.7		Length of – main 47024.2
49	200	797	.3200	500.	790	.1280	780.	1040	.1680	1352		cross section 7.66976
50	150	872	.2700	453.75	1180	.1425	1305.	1370	.1665	1759.5		Weight 63363.34
51	140	911	.2590	462.84	1440	.1624	1814.4	1690	.1918	2499.		
546	1776		29520	4669.88	13020	15736 (over)	14362.2	13570	16437	15530.9 (over)		

Total no of Lamps — . 11078.
Length of Distributing Wires — —
Cross Section of " " — 29.12275
Weight of " " — 48950.005
Length of "+" main wires — 45880.
Cross Section of "+" main wires — 8,18609
Weight of "+" main wires — 75287.21
Length of "−" main wires — 47024.2
Cross Section of "−" main wires — 7.66976
Weight of "−" main wires. 66363.342

75.
.63
49
187000
6

1.14) 137000
.13

23
24
47

1092
386
1478
20
1498

73 26
366

28
13
41

28
14
33.5

49 35
28 28
77 63

1141
399
1540

Both [illegible] of Pipe

1
1199
599
1798

2 | 6615
.3307

D	24	Wires	1798 feet
DM	47	Wires	410 feet
	44	wires	208 feet
	20	wires	20 feet
2	23	wires	20
	28	–	1498
	41	"	202
	77	"	157
	63	"	157
	35		203
	49		15
	35		15

3 1540

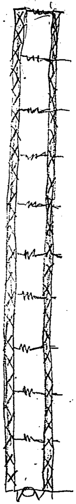
1. Feet Cross Section No. Wires

100 ohm 200 ohm

1798

2.

3.



214
194
220
176
1?2.4
?112

.5.25
5
26.25

124
.124
136.4 Volts

2.6.25
2.62
180
20960
262
47160

5/12.4
2.5
15, Volts

5/12.4
2.48
14.88

For 120 Volts to start with 1/5 more Volts fall

5/12.4
2.48
14.88 Volts

30 Lamps at equal distances 60' along a conductor each having 10 Ohms in the conductor will have a fall of E. M. F. from 100 to 87.6 Volts

12.4 Volts
87.6
100.0

The conductor will weigh 440.7 lbs.

10 Lamps will have the same fall and conductors will weigh $\frac{440.7}{3}$ = 146.9 lbs.

See page 77

386
198
10
208.

1320
208
1112

To square No. 1

2/370
185
.22.5
29
235
471 5
10
264
62
87
26
9205
10
137
34.7
139
39.3
1267.5 feet

1267 feet

~~100~~
270 lamps

200 lbs for 10
27
200
5400 lbs Cu

3915
2940
6855 in mains of ott
5400
1455
1512 in distribution
2967 lbs
1483

6855
1512
270) 8367 (30 lbs per lamp
810
67

6,1336
2,7589
2,7589
18 1.2553

2,9067

8.7 lbs
1614
538 lbs

188
386

~~577~~ feet

40.7 for 10 lamps
.15

2035
407

610.5 for 10 lamps

12.4 volts
2.5
3.9
14 volts fall

1483 : 610.5 :: 14 :

188
386

574

2.7589
2

5.5178

9.83

3.2553
2

6.5106
5.5178

.9928

440.7 lbs Cu

$1800^2 : \cancel{574}\, a^2 :: 440.7 : X$

comp 1800^2 3.4894
log 440.7 2.6442
log a^2 5.5172

1,6508

6.1336

44.7 lbs

Square 1

	14.88	1.1726
	146.9	2.1670
comp	1800	6.7447
	1800	6.7477
		6.8290 - 70
	a^2	2.7589
		2.7589
	b	1.4314
comp	c	6.5280
		.3062

5.6564

2 Volts

1.1726
1.13456
.0378

6.8290
.0378
6.7912

a = 574
b = 120 + 150 = 270
c = 2967

From page 71

Let a = distance furthest lamp is away
b = no lamps ÷ 10
c = amount of copper at hand
x = fall E. M. F.
d = amount to 10 lamps by Table 100ths to lamps

$1800^2 : a^2 :: 146.9 : d$

$$\frac{\frac{14.88}{c}}{bd} = X$$

$$\frac{14.88\,bd}{c} = X \qquad d = \frac{146.9a^2}{1800^2}$$

$$\frac{14.88 \times 146.9\,b\,a^2}{1800^2\,c} = X$$

13.64 Volts in place 14.88 to represent fall from 110 volts

a 293
10
385
20
143
5873

C 190 lamps on one side
1267 feet
19
200
3800 lbs Cu.

140
200
28000
3800
6600

3736
2997
6733

133
1517
1640

D 1517
+ 3736
− 2997
333) 8250 (25 lbs Cu to lamp
666
1590
1332

6.8290
587 2.7686
587 2.7686
19 1.2788
1640 3.7852
.4302
190 7.7212
330 2.5185
.6699

486 6.8290
2.6866
2.6866
1.1461
7.0938
2.76 .4421
.3378
256 .4083
4.66 Volts

Square 3

1470
2568
1980
6018 lbs

300 Lamps:

105
30
3150

6018
3150
4868 lbs [illegible]

10
137
20
394

 From pages 76 & 77

13.64

	1.1348
	5.6564
	6.7912
$b = 14$	2.6866
$a = 486$	2.6866
$c = 806$	1.1461
	7.0894
	6.3999

Square $\underline{\underline{2}}$

2.49+

0.7370
2.1670
6.7447
6.7447
6.3934

5.456

5.6564
.7369
6.3933 .0002473

1.

.2.5 Volts can be lost in wires leading from main distributing

13.64
2.5
5.456

From page 77

Let y = amount Cu required to give fall of 2.5 Volts

No. lamps = b

Furthest lamps a feet away.

$1800^2 : a^2 :: 146.9 : d$

$5.456 d b = y$

$$\frac{5.456 \times 146.9 a^2 b}{1800^2} = y$$

$.0002473 \, a^2 b = y$

Square 1

10
386
20
188
604 feet = a

b = 15

6.3933 − 10
2.7810
2.7810
1.1761
3.1314

1350 lbs

10
195
20
390
615

b = 12

6.3933
2.7889
2.7889
1.0792
3.0503

1120
24.70

Square 2 ∓

10
385
20
71
√486

14

(143
71.5

6.3933
2.6866
2.6866
1.1461
2.9126

818

10
387
20
72
√489 15

6.3933
2.6893
2.6893
1.1761
2.9486

88.7
1705

Square 3

10
394
20
90
514

140

6.3933
2.7110
2.7110
2.1461
2.9614

916

10
390
20
90
510

12

6.3933
2.7076
2.7076
1.0792
2.8877

77.3
1689.6

Block 4

395
20
190
20
405
1020
510

6.3933
2.7076
2.7076
1.1461
14 2.9546

1.8085
901.

1.8085
1.2304
17 3.0389

1090
1991

Block 5

10
384
20
178
20
400
10.

1022
511

6.3933
2.7084
2.7084 1.8101
16 1.2041
3.0742 1030

1
1.8101
14 .1464
2.9562 904
1934

Block 6

198
267
465
5
470
30

10
493
20
523

6.3933
2.7185
2.7185
1.3010
20. 3.1313

1350

Block 6 & 7

10
16.2
25
190
387

6.3933
2.5877
2.5877
0954 2
9 2.5229

333
1683

Block 8

10
380
20
119
~~20~~
529

19

6.3933
2.7235
2.7235
1.2788
3.1191

1310

Block 9

Both sides

10
376
20
296
20
341
10
1073
√536

150
120
100
370

6.3933
2.7292
2.7292
37. 1.5682
3.4199

2620

Block 10

Both sides

10
338
20
188
20
300 ~~78~~
20 23
193
10

1099

549

6.3933
2.7396
2.7396
1.2553

3.1278 1340

Block 11

20
193
20
487
20
188
10

2 | 938

√ 469

4.0
15.0
40
23.0

6.3933
2.6712
2.6712
1.3617

3.1074 1280

Block 12

20
494
10
1524 28
530
1054
527
263

6.3933
2.4200
2.4200
1.4472
2.6805

399

140
20
20
180 4
90

6.3933
1.9542
1.9542
0 6021
.9038

81
480

Block 13

$2\overline{)399}$
199
81

Sop block

498		6·3933
200		2·4983
298		2·4983
17	7·21	0·8573
315		2·2472

175
455

Block 14

30
10
70
20
180
162
~~75~~
472
236

6.3933
2.3729
2.3729
5. 9.6990
2.8381

69 ft

Block 15

29.4
243
14.2
286.6
143.3

6.3933
2.1593
2.1593
1
1.7119 54.5

14
264
29
307
153

6.3933
2.1847
2.1847
1
1.7827 61.

60 lamps.
200 feet

6.3933 20
2.3010
2.3010
0.7782
1.7735 60

134
30
30
194
97 4

6.3933
1.9868
1.9868
0.6021
.9690 9

204.5

Block 16

15
242
30 4
287
143

6.3933
2.1553
2.1553
.6021
1-3060

20

10
10
40

Block 17

30	6.3933	30 lbs
335	2.2945	
30	2.2945	
395	11	
197	1.9823	96

both sides

30	6.3933	
268	2.5378	
20	2.5378	
363	12.10792	
10	2.5481	353
691		479 lbs
345		

Block 18

30	6.3733
10	2.6415
250	2.6415
20	7 0 8451
140	
438	2.5214

332
20
352

Block 19

40	6.3933	
262	2.3579	
20	2.3579	
95	9 0.9542	
40		
457	2.0633	11.5
228		
180	6.3933	
30	2.1139	
30	2.1139	
20	4. .6021	
260	1.2232	20
130		
		70
		205

Square 20

40
190
20
320
20
191
10
763
381

6,3933
2,5809
2,5809
1,5161
14 2.6712

469

Square 21

10
234
20
142

6

10
224
20
247
20
142

663

.46
20
40
35
135

6.3933
2.8235
2.8235
1.1303

3,1706

1408 lb

Square 22

30

370	6.3933
20	2.2900
390	2.2900
195	1.0792
	2.0525

115

145

Square 23

108
370
20
275
20
335
10
1040
520

6.3933
2.7160
2.7160
21 ~~7~~ 3222
3.1475

1410

34
320
49
407

Square 24

24
16
286
20
215
20
370
20
218
1183
591

6.3933
2.7716
2.7716
30 1 4771
3.4136

2590

Block 25

10	6.3933
282	2.7177
20	2.717 / 7
428	30 1.4771
20	3.3058
285	
110 45	
522	

2020

Block 26

10	6.3933
320	2.6444
20	2.6444
204	1.3802
20	24 3.0623
297	
10	
881	
441	

1150

Block 27

10
198
20
218
20
202
10
678
33.9

6.3933
2.5302
2.5302
13 1.1761
2.6298

426

Block 28

10
285
20
188
20
331
10
864
432

6.3933
2.6355
2.6355
1.3222
2.9865

21.

970

Block 29

10		6.3933
179		2.4502
20		2,4502
138	13	1.1139
20		2.4176
187		
10		
564		
282		

277

Block 30

30
21.3
10
12.5.3
125

6.3933
2.0969
2.0969
8 0.9031
1.4902

31.0
50
35
116

Block 31

10
232
20
88
20
246
20
84
20

$\boxed{740}$

370

6.3933
2.5682
2,5682
1,2041

2.7338

542

Block 32

249	6.3933
20	2.6866
240	2.6866
20	16 1.2041.
227	2.9706
20	
176	
20	
972	
486	

935

Block 33

10
287
20
97
020
270
20
$\boxed{724}$
362

6.3933
2.5587
2.5587
12 1.0792

2.5899

390

Block 34

10		6.3933	
193		2.6385	
20		2.6385	
219			
20	.14	1.1461	
167		2.8164	655 lb.
20			
211			
10			
870			
435			

Block 35

10
3,0
20
186
20
330
10

886
443

6.3933
2.6464
2.646.4
20 1.3010

2.9871 971.

Block 36

10	6.3933	
188	2.4757	
20	2.4757	
158	13 1.1139	
20	2.4586	287
192		
10		
598		
299		

Block 37

108

Block 38

100

Block 39

ques 30

Block 40

10	6.3933
177	2.6053
20	2.6053
196	6. 0.7782
403	2.3821

241

Block 41

16	6.3933
215	2.3118
20	2.3118
154	7 0.8451
16	1.8620
413	
205	

73

Block 42

10	6.3933
194	2.2714
20	2.2718
141	69 ~~0.9542~~
10	~~1.8907~~
375	
187	

~~80~~

60

Block ~~Rd~~ 44

32	6.3933
10	2.6702
194	2.6702
20	22 1.3424
214	3.0761 1200
20	
196	
20	
220	
10	
936	
468	

Block 43

10
310
20
186
20
330
10
$\boxed{88.6}$
443

	6.3933
	2.6464
	2.6464
20	1.3010
	2.9871

971

Block 35

10
296
20
1[illegible]
20
296
10
$\boxed{792}$
396

~~2.5966~~
2.5977
2.5977
1.1761
.6393
2.7648
.0666
.8312

582 — 678

Block 45

42
222
20
52

$\boxed{336}$
168

6.3933
2.2253
2.2253
5 0.6990

1.5429
4 0.6021

2.1450

20

140

160

Block 46

5 2	6.3933	5-0
22 7	2.6160	
2 0	2.6160	
114	9 09542	380
413	2.579 5	430

Block 47

$$\begin{array}{r} 52 \\ 230 \\ 20 \\ 43 \\ \hline 313 \end{array} \quad 7 \quad \begin{array}{r} 6.3933 \\ 2.4983 \\ 2.4983 \\ 0.8451 \\ \hline 2.2350 \end{array} \quad \begin{array}{r} 20 \\ 172 \\ \hline 192 \end{array}$$

Block 48

10	6.3933	
240	2.6117	50
20	2.6119	
179	19 1.2788	785
409	2.8955	

Block 49

10
244
20
115
20
250
20
148
10

837
418.

6.3938
2.6212
2.6212
20 1.3010
2.9367

864

Block 5-D

100

Block 51

40
160
20
286
20
156
26
285
10
1981
490

6.3933
2.6902
2.6902
14 1 1461
2.9198

831

40.890
81.306
122196

187000
122196
64.8.04 for equalizing

40890 1.15

4.6116
0.0629
4.6745

47.200 with straight wires between the lbs.
mains 81.366
128.506

187.000
128.506
58.5 00

2470
1701
1689
1991
1934
16.83
1310
2620
1340
1280
480
455
69
204
40
479
352
205
469
1408
145
1410
23534
17366
40890

6

2590
2020
1150
426
970
277
116
542
935
390
655
971
287
100
100
30
241
73
60
1200
971
160
436
192
785
864
10.0
831
17366

6

4

1.1349
2.1671
9.2392
2.5412 347.7

405	2.6075	63
347.7	2.5412	45
1.165	.0663	18

Amount Cu to be multiplied by 1.165 to give amount wit straight wires

1000 feet out
2000 in total ~~gives~~ takes 125 lbs of Cu to make one Ohm

10 lamps at equal distances along this will ~~take~~ have a fall of 5.24 Volts in 100 or 5.764 Volts in 110

1800 feet out will take 405 lbs. of Cu.
10 lamp along decreasing conductor will take 146.9 lbs and have 13.64 Volts fall

5.764 : 13.64 :: 146.9 : 347.7
347.7 lbs to have a fall of 5.764 Volts from 10 lamps along decreasing conductor 1800 feet long.

7.1 lbs both wire

3.55 each wire

1674
937
1602
974
1347
1694

8228 feet

0.5502
$\bar{2}$.7354

1.8148

65 wires

58 500 lbs

58.500 4.7672
8,228 3.9151

.8521

7.1 lbs per foot

No 10 wire
lbs 94.6 1.9759
feet 1740 3.2405

$\bar{2}$.7354

.0544 lbs per foot

Length of equalizing mains

29
137
34
137
36
89
61
264
44
328
54
110
64
20
188
40
39

1674

30
492
39
168
42
156
10

937

556
600
157
199
70
20

1602

2 | 285
142
10
35
234
26
249
20
115
35
108

974

2 | 498
249

1162
556

1162
185
546

602
10
157
32
546

1347

155
47
167
41
195
42
378
49
298
48
222
53

1694

To find point of
greatest economy to run
wires to

a = distance AB one station
b = BC

Lamp at C takes
c^2 lbs of Cu
Lamp at b takes b^2

Let x = Bx where lamp
is placed

then

~~$(a+x)^2$ = Cu~~

$a^2 + 4x^2$ = Cu it takes supplied from A

$(a+b)^2 + 4(b-x)^2$ = Cu it takes supplied from C

$a^2+4x^2 = b^2+4(b-x)^2$

$= b^2+4b^2-8bx+4x^2$

$8bx = b^2-a^2+4b^2$

$x = \frac{5b^2-a^2}{8b}$

$a+b = 1267$

$a = 920$

$b = 347$

2,5403
2

$\sqrt{.0806}$

2.9634 $b^2 = 122000$
2

5.9276 $a^2 = 846000$

610000

236000

2788

122000
5

610000

347
8

2776

5.3729

3.4452

1.9277

85 feet

$a^2+4x^2+b^2+4(b-x)^2$ must be a minimum

$8x - 8b + 8x = 0$

$b^2-2bx+x^2$

$16x = 8b$

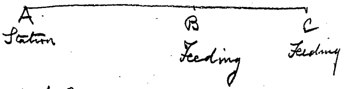
$x = \frac{1}{2}b$

$a^2+5x^2+b^2+5(b-x^2)$

$10x^2 - 10b + 10x = 0$

$x = \frac{1}{2}b$

$a^2+4x^2=$



$AB = a$
$AC = c$
$BC = b$

~~[illegible]~~

$a^2+4x^2 = c^2+4(b-x)^2$

$a^2+\cancel{4x^2} = a^2+4b^2-8bx+\cancel{4x^2}$

$\cancel{8b}x = \frac{c^2+4b^2-a^2}{\cancel{8b}}$

$x = \frac{c^2+4b^2-a^2}{8b}$

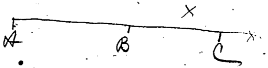
$c = 1267 \quad c^2 = 1607000$
$a = 920 \quad a^2 = 846000$
$b = 347 \quad b^2 = 122000$

$$\begin{array}{r} 122000 \\ 4 \\ \hline 488000 \end{array} \qquad \begin{array}{r} 1607000 \\ 488000 \\ \hline 2095000 \\ 846 \\ \hline 1.249000 \end{array}$$

$$\begin{array}{r} 3.1028 \\ 2 \\ \hline 6.2056 \end{array} \quad 10 \qquad \begin{array}{r} 347 \\ 8 \\ \hline 2776 \end{array}$$

$$\begin{array}{r} 6.0966 \\ 3.4435 \\ \hline 2.6531 \end{array}$$

$x = 450$
397



$AB = a = 2$

$BC = b = 3$

$AC = c = 5$

$$a^2 + 4x^2 = c^2 + 4(b - x^2)$$

$$a^2 + \cancel{4x^2} = c^2 + 4b^2 - 8bx + \cancel{4x^2}$$

$$8bx = c^2 + 4b^2 - a^2$$

$$x = \frac{c^2 + 4b^2 - a^2}{8b}$$

$$\frac{25 + 36 - 4}{24} = \frac{57}{24}$$

1.7559
1.3802
.3757   2.3

$a = 9$

$b = 3$

$c = 12$

144
36
180
81

$$x = \frac{99}{24} = 4\tfrac{1}{8}$$

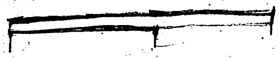
$a = 8$

$b = 3$

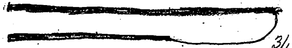
$c = 11$

121
36
157
64

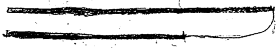
$$\frac{93}{24}$$



If the cable runs between two points there will be a fall of E.M.F due to the line being



3/4



137
20
157
7.4
157
1299
1304.7

157
2
314

052
3.2
104
156
166.1

520 lamps

1314.7
166.1

3.1185
2.2204
.8981

7.9

1/4 Volts fall

2.5
1.25
3.75 Volts fall

264
16
10
284
2
568

9.8

284
7.1
284
1988
2016.4

130
30
100
40
10
100
410

410
0
9.8
41
98
~~398~~
401.8

2 Volts fall
4.5 Volts

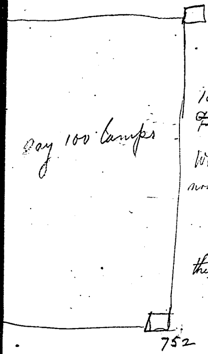
765
1267

18
49

49
7
343

18
72
1268

Problem.



13
193
20
487
20
188
13
934.

1000
~~934~~

What is the most economical point of division?
Say X feet from the 752 division then 1000 − X from 1207

$\frac{x}{10}$ lamps supplied from 752 70.5 lbs

$\frac{752}{1504}$

$\left(100-\frac{x}{10}\right)$ lamps from 1207 182.
2414

$\frac{x}{10 \times 10}$ 70.5 Cu. in main to 752

$\left(100-\frac{x}{10}\right)\frac{1}{10}$ 182 Cu. in main to 1207

$\frac{.0002473\, x^2\, \frac{x}{10}}{10}$ = Cu in distributing from 752

$\frac{.0002473\,(1000-x)\left(100-\frac{x}{10}\right)}{10}$ = Cu in dis- from 1207

$70.5 = 10a^2$ ~~7~~ $.0002473 = 10\varepsilon$
$182 = 10b^2$ ~~7~~. $\varepsilon = .00002473$

$\frac{x}{100}\ 70.5 + \left(10 - \frac{x}{100}\right) 182$

$+ \frac{.00000\,2473\ x^3}{10} + \frac{.000\,2473 \left(1000 - x\right)^2 \left(100 - \frac{x}{10}\right)}{10}$

$=$ min

$.705x + 1820 - 1.82x$

$1000000 - 2000x + x^2$

$\cancel{100000000} - \cancel{200000x} + 100x^2$

$\cancel{100} \ 100000x + 200x^2 - \frac{x^3}{10}$

$1000000000 - 3000000x + 300x^2 + 11x^3$

$24730 - 74.1900000x + .07419x^2 - .000\,02473x^3$

$2473 - 7.419x + .007419x^2 - .00000\,2473x^3$

$.000\,2473$
300000
74.1900000
$.07419$

74.19
1.82
76.01
$.705$
75.305

7.419
1.82
9.239
$.705$
8.534

$(\ )\ - 75.305x + .07419x^2 =$ min

$\frac{2}{14838}$

$.14838x = 75.305$

1.8768
1.1712
2.7056

$.0000\,2473$
6
$.00014838$
$.0014838$

507 feet $= x$

$.014838\ x = 8.534$

$(1000 - x)^3$

$1000000000 - 3000000x + 3000x^2 - x^3$

~~.0000 2473~~

$.00000\,2473$

2473
3
7.419

$.000002473$
1000000000
2473.000000

$.00002473$
300
$.007419000$

Try $x = 300$
$1000 - x = 700$
3.0
7.0

70.5
3
211.5 lbs.

6.3933
2.4771
2.4771
.4771
1.8346

211
68.3
279.3

182
7
1274 lbs.

2122
279.3
2401.3

6.3933
2.8451
2.8451
0.8451
2.9286

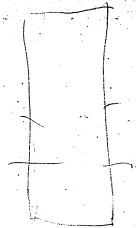
1274
848
2122

$x = 700$
$1000 - x = 300$
7.
3.

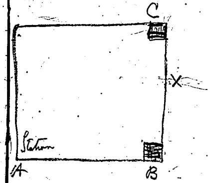
211
848
1159

1159
1342
2501

1274.
68.3
1342.3



Let x = 7



$AC = a$ n lamps

$AB = b$ Lamps $\frac{x}{c}\, n$ towards C

$C\cancel{X} = x$ $\frac{c-x}{c}\, n$ toward B

$CB = c$

$Bx = c - x$

Let F = Constant in mains

E = constant in distributing

F = Page 217

E =

$\frac{x}{c} n a^2 \mathcal{F}$ = wt. main AC

$\frac{x}{c} n x^2 \mathcal{E}$ = wt. distrib. C x

$\frac{c-x}{c} n b^2 \mathcal{F}$ = wt. main AB

$\frac{c-x}{c} n (c-x)^2 \mathcal{E}$ = wt. distributing Bx

$$\frac{x}{c} n a^2 \mathcal{F} + \frac{x}{c} n x^2 \mathcal{E} + \frac{c-x}{c} n b^2 \mathcal{F} + \frac{c-x}{c} n (c-x)^2 \mathcal{E}$$

$$= \frac{n a^2 \mathcal{F}}{c} x + \cancel{\frac{n \mathcal{E}}{c} x^3} + (n b^2 \mathcal{F}) - \frac{n b^2 \mathcal{F}}{c} x$$

$$+ \frac{c^2 - 2cx + x^2}{c} (c-x) n \mathcal{E}$$

$$\begin{array}{l} c^3 - 2c^2 x + c x^2 \\ \quad - c^2 x + 2 c x^2 - x^3 \\ \hline (c^3 - 3c^2 x + 3 c x^2 - x^3) \frac{n \mathcal{E}}{c} \end{array}$$

$$+ (n \mathcal{E} c^2 - 3 c n \mathcal{E} x + 3 n \mathcal{E} x^2 - \cancel{\frac{n \mathcal{E}}{c} x^3}$$

$$\frac{F}{6\mathcal{E}} = \begin{array}{r} 5.0969 \\ 4.6067 \\ 9.2218 \\ \hline 8.9254 \end{array}$$ Decreasing

$$\frac{F}{6\mathcal{E}} \quad \begin{array}{r} 5.0969-10 \\ 4.5403 \\ 9.2218-10 \\ \hline 8.8590-10 \end{array}$$ Same size

$$\begin{array}{r} 8.9254 \\ 8.8590 \\ \hline .0664 \end{array}$$

log $F = 5.0969$
log. $\mathcal{E} = 5.3933$ decreasing
$= 5.4597$ same size

$$(\quad) + \left(\frac{na^2F}{c} - \frac{nb^2F}{c} - 3cn\mathcal{E}\right)x$$
$$+ 3n\mathcal{E}x^2 = \text{min}$$

$$6n\mathcal{E}x = \frac{nb^2F}{c} + 3cn\mathcal{E} - \frac{na^2F}{c}$$

$$x = \frac{b^2F}{6c\mathcal{E}} + \frac{c}{2} - \frac{a^2F}{6\mathcal{E}c}$$

$$x = \frac{(b^2-a^2)F}{6\mathcal{E}c} + \frac{c}{2}$$

$$= \frac{(b-a)(b+a)F}{6\mathcal{E}c} + \frac{c}{2}$$

10 lamps
200 feet main — 1:25 — 10 Volts for 1 lamp
1 lamp $\frac{1}{80000}$ — $F = .0000125$
Decreasing — $\mathcal{E} = .00002473$ — 2.5 Volts
Uniform Size — $= .00002882$

$$
\begin{array}{lr}
J & 5.9486 \\
 & 8.9254 \\
\hline
 & 4.8740 \\
C = 9000 & 3. \\
\hline
 & 1.8740
\end{array}
$$

74.8

c - x = 574.6 feet

$$
\begin{array}{lr}
 & 4.8740 \\
C = 984 & 2.9930 \\
\hline
 & 1.8810
\end{array}
$$

$$
\begin{array}{r}
2\,)\,984 \\
\hline
492 \\
76 \\
\hline
568
\end{array}
$$

76

c - x = 568

a = 754

b = 1207

c = 1000

$$
\begin{array}{r}
1207 \\
754 \\
\hline
453
\end{array}
\qquad
\begin{array}{r}
1207 \\
754 \\
\hline
1961
\end{array}
$$

$$
\begin{array}{r}
2.6561 \\
3.2925 \\
\hline
5.9486 \\
5.0969 \\
\hline
1.0455 \\
9.1715 \\
\hline
1.8740
\end{array}
\qquad
\begin{array}{r}
3.7782 \\
5.3933 \\
\hline
9.1715
\end{array}
$$

x = -74.8 + 500

c - x = 1000 + 74.8 - 500

c - x = 7 6

20
193
20
233

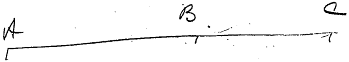
984
233
751
568
183

c = 492
10
13
13
10
538

4.8740
538 2.7308
2.1432

140
269
409

538
269



~~A B = a~~ $\quad AC = a$

~~B C = 1~~ $\quad AB = x$

$BC = a - x$

$$x^2 \mathcal{F} + (a-x)^2 \mathcal{E} = \text{min}$$

$$x^2 \mathcal{F} + a^2\mathcal{E} - 2ax\mathcal{E} + x^2\mathcal{E} = \text{min}$$

$$2a\mathcal{E} = 2(\mathcal{F}+\mathcal{E})x$$

$$x = \frac{\cancel{a}\mathcal{E}}{\mathcal{F}+\mathcal{E}} = \frac{a\mathcal{E}}{\mathcal{F}+\mathcal{E}}$$

~~60~~ 247.3

$$\begin{array}{r} 125 \\ 247 \\ \hline 372 \end{array}$$

$$\frac{247}{372} \qquad \begin{array}{r} 2.3927 \\ 2.5705 \\ \hline .8222 \end{array}$$

66.4. 2/3 decreasing conductor

831	452
44	10
180	1210
10	35
1065	134
	10
	762

Same size

288
125
413

288 2.4594
413 2.6160
.8434

69.7% of distance out is the place to put the distributing box

In Block 1

1207	~~2??~~
	185
30	22
10	235
10	30
386	472
20	20
188	452
644	34
2	335
1288	10
	831

4.5289
2.5866
1.9423

87
193
280

324
28
10
20
386
193

a = 831
b = 472
C = 24
64
25
193
20
267
20
190
25
162
30
1020

a+b
831
472
1303

a-b
831
472
359

615
544
71
20

1020
510

Same size
1

2.5551
3.1148
8.8590
4.5289
3.0086
1.5203

33.2
510
644

1000

2.25)1000(4.400
980
1000

150
5
750

1500
26
9000
3000
39.000

26)4400(170
26
180
0

15)170(11
15
20

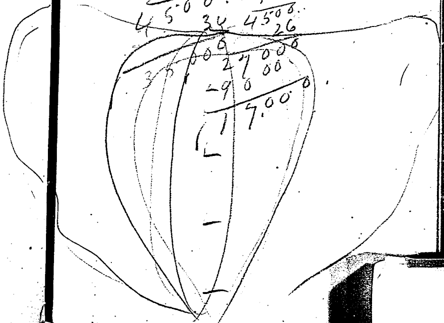
26)15900(575
130
290
188
1.20

.5)575 feet
100

5.

500
9
4500

9
500
4500
26
27000
9000
17.000



21-
38. along mill St-
20.

33 - 20 - 22 -

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
			18 18 18 18 18 18 18		2020 2020 2020 2020 2020 2020 2020 2020 2020 20	21 21 21 21 21 21	22 22 22 22 22	23 23 23 23		25 25 25	26 26		28	27	30 30 30 30 30		32 32	33 33		35		37
			7		19	6	5	4		3	2		1	1	5		2	2		1		1

Frontage of buildings on Wall St., N.Y. &c —

38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
38 38		40						46		48 48		50 50 50 50		52		
2		1						1		2		4		1		

55	56	57	58	59	60	61	62	63
			58 58 58		60 60			63 63
			3		2			2

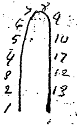

Democratic
Constituent

Menlo Park Notebook #167 [N-80-09-03]

This notebook covers the period August-September 1880. It was used by various members of the laboratory staff to record notes and drawings relating to tests of lamps, carbons, and vacuums. The label on the front cover is marked "Book for lamps Sep 3, 1880." The book contains 284 numbered pages.

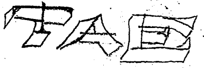
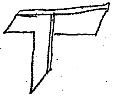
Blank pages not filmed: 26-27, 52-91, 104-109, 116-125, 128-231, 238-239, 242-259, 262-281.

X E-172 N-80-09-03



9/15/1

4	1
2	8
3	1

No Lamp	Remarks
1	Large Bamboo Aug 14 1880 the carbon had a Bad spot Close to the clamp on the Positive side and Broke With full current By T A E
2	Large Bamboo 
3	Regular 
4	Regular

No Imp	Remarks
5	Large Bamboo
6	Large Bamboo
7	Regular
8	Large Bamboo Broke By falling on the floor-

No. Tamp.	Remarks
9	Large Bamboo
10	Regular No 2
11	Large Bamboo
12	Large Bamboo

No Lamp	Remarks
13	Regular No 2
14	Regular No 2
15	Regular No 3
16	Large Bamboo

No Lamp	Remarks
17	Regular No 3 Carbon was split in clamp
18	Regular No 2
19	Regular
20	~~Regular~~

No Lamp	Remarks
21	Regular No 2
22	Regular No 3
23	Regular No 2
24	Regular

No Lamp	Remarks
25	Regular No 2
26	Regular No 2
27	Regular no 3
28	Regular no 3

No Tony.	Remarks
29	Regular No 2
30	Regular No 4
31	Regular No 4
32	Regular No 4.

No Yang.	Remarks
33	Regular No 5
34	Regular No 4
35	Regular No 4
36	Regular No 3

No Tary	Remarks
37	Regular No 4
38	Regular No 4
39	Regular no 5
40	Regular No 4

No Lamp	Remarks
41	Regular No 3
42	
43	
44	

No Lamp	Remarks
45	
46	
47	
48	

No Gang.	Remarks
49	
50	
51	
52	

Heel Tested Sep 10, 1880

good	Bad
~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~	||||

Hill Tested Apr 18, 1880

GOOD	BAD SPOTS ALL OVER	SINGLE BAD SPOTS	BRIGHT on one SIDE	BROKE IN HANDLING	SPLIT In FIBER	SPLIT IN CLAMP	BAD SPOTS IN MIDDLE
𝍸 𝍸 𝍸 𝍸 𝍸	𝍸 𝍸 𝍸 |		||||	||		|	|

RECEIVE. FROM. FLAMER

56. 7 Left on the pump

Hill Tested Sep 20

GOOD	BAD SPOTS ALL OVER	SINGLE BAD SPOTS	BRIGHT on one side	Broke in handling	split in fiber.	split in clamp	Bad spots in middle	
卌 卌 卌	卌 III	II	卌	I		I		

Received from Flanner-
34. 3 Left- on pump

Fibe Tested Sep 21 1889

Good	BAD SPOTS ALL OVER	SINGLE BAD SPOTS	BRIGHT NOZZLE SIDE	BROKE IN HANDLING	SPLIT IN FIBER	SPLIT IN CLAMP	BAD SPOTS IN MIDDLE CARBON
/	///						

Hill Tried also

good	Bad spots all over.	Brighter on one side	Broke in handling	Split in Fibers.
Split in Clamp	Bad spots in middle of Carbon			

Hill Tested Do

Good { Bad spots all over { Bright on one side { Broke in handling

Split in Fiber { Split in Clamp { Bad spots in middle of the carbons

Hill Tested Lamps 1880

Good	Bad spots all over	Single Bad spot	Bright on one side

Broke in handling	Split in Files	Split in Clamp	Bad spots in middle of Carbons

Hill Tested Slip 1880

good { Bead spots all over- { Single Ball spots } Bright on one side

Broke in handling } Split in Fiber- { Split in Clamp / Ball spots in middle of Carbon

Nov 9 1880

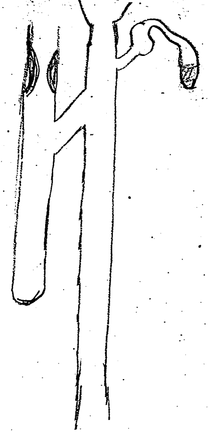
Carbon tests - Started 2-20
this pump has got the mill full
Tube contraction 30 - tube 130
the spark began to show
in 3 minuts
5 minuts 1/8
10 minuts spark 1/2 in along the wire
12 - - the spark has all a long
one Wire
13 - - the spark was
on Both Wires
Stopped the pump after it
had Run 15 minuts the spark
had almost left the guage

try three different ways
of bringing up Lamps

first way bring the
Carbon up to a
invisable Red bring to
25 Candles and burn
for a few minuts at 25
and then to 16 and burn
for one hour

Second way put the
Current on with one
hundred ohms Res
and let burn ~~for about
one hour without stopping~~
untill you get a good
Vacuum

I treat for Lamps
have two hundred ohms Res
for this Lamp and then
get a high Vacuum
and Touch the switch
for instant only
do not let Run when
any air is coming out
of the carbon



Dec 15 - 1880

try three Lamps and see if they test different from one another

(No 1 Lamp

Put a Lamp on the pump and have 7 or 8 hundred ohms Res and bring to an invisible Red and bring up to 25 candles for a few minuts and then to 16 and Run for one hours at 16 Candles

Dec 15- No 2 Jump

Put on the pump and
have one hundred dimes
Keep get a high Vacum
and then put the
current on and dont
take it off untill
you get a high Vacum

Lamp No 2 Dec 15 —

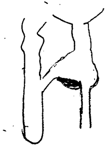
Put the lamp on pump
and get a high Vacuum
and then touch the
Switch for instant only
dont let it Burn untill
15 minuts before it is
Ready to come off an then
Let Burn for 15 minuts before
taken off have about
five hundred [illegible]
dont put the ~~Swit~~
Current on when ag ain
is

a burning out of the
Carbons ——

Dec 18 - 1880

The Latest from T.A.E
on heating the Lamps is
When you get a good
Vacuum heat With all your-
Resistance in an invisible Red
Keep the Current on untill
you cant see any air a
Coming out then put in
one Plug and let the air
all go a gain then Second
and third Plug the same
as first then use your
Resistance Board untill
you get your Lamp up to
25 candles let burn untill
all the air is gone and
then let your Lamp Burn
for 80 minuts at 16 Candles

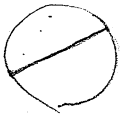
Mar 12 1880



Dec 27 1880

Pump 30X130 it Breaks the face tube When used a short time

No of Lamp	exhausted	Sealed off			



121
142
124

No off Pump	STARTED	SEALED OFF	Remarks
~~1 C5~~	~~8 20~~	~~30~~	~~broke in the combustion~~

0864
0864
6464
9586

7778 5990

0792
0792
6464
9957

8005 6326

No of Families	[illegible]	Remarks

40 X 145 did not set a Vacum quick Enough ~~the stoppee to try another~~

Tester - 50 - 120
started 10 - 45
the fall tube was to small for the contractions and dident take out any air -

---

Tester - 50 X 130
Started 11 + 30
did not work the Contractions was to Large for the fall tube

Tester- 50 x 145
Started at 2 30
Runs to much mercury
and could not
get a Vacuum N.G.

30 x 145 ~~Started 2 50~~
Started 205

50 x 115 started 235
no good the feed tube
was to small and
did not take the air
out fast Enough

Tests - 30 - 130
the spark was ~~[illegible]~~
[illegible] way down [illegible]
the wires [illegible] 15 minutes stoped
to try it the second time

started the second time
at 605 the cork leaked and
did not get a [illegible]

started again at [illegible]20
and broke the pump

Sat Nov 19 1880

heated the mercury to 180 degrees and then started the pump at 108 the spark left in 14 minutes

---

Started the pump With Lamp on at 126

Oct 4

Carbon Tester

40 by 145

14 By 92

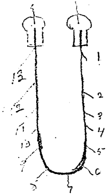
16 x 118

16 x 106

30 X 130

Oct. 13 Tested Carbons

Oct. 14. 1880
Position of faults
in Testing
Carbons



Menlo Park Notebook #168 [N-80-12-13]

This notebook covers the period December 1880-January 1881. The entries are by John W. Lawson and consist of notes and a few drawings relating to experiments on plating and chemically treating carbons. Sixteen loose pages found in this notebook were torn from another notebook and identified as "experiments tried." They appear to have been copied from a "Bk 2" and relate to the experiments recorded in Menlo Park Notebook #168. The book contains 283 numbered pages and has been used in both directions.

Blank pages not filmed: 1, 20-270.

Filming order: pp. 2-19; pp. 283-271 [in reverse page-number order].

~~Sept.~~ Dec. 13 —

Experiment of plating ~~carbon~~ the clamping points of carbon loops with copper — Gave satisfactory results — Orders to plate all ~~the~~ loops in the same manner.

S

~~Sept.~~ Dec. 18

Experiment of plating with silver - Result exceedingly good, deposit clean and homogeneous -

" "

Tried iron, using ~~the~~ double sulphate of iron & ammonia - Bright, clean deposit. -

~~After boiling in solution and drying in oven, they are to be taken to Neal who will heat them in reg. way — after passing through furnace their resistance is to be tested and if lowered to any extent let them be boiled again in the Pt Chlr and again treated by Neal —~~

Dec. 29/80 —

Find I have been working with polarized batteries in plating the carbons for the lamps — Plating Ag & Cu.

1/4/81 — Platinized carbons —

~~Placed the carbon loops in boiling Platinum chloride solution after they have been in solution 15 minutes They are to be taken out and~~ ~~washed well in water for 15 minutes but~~ ~~dried at a temperature of 75° C. — Then placed in lamp and treated in reg. way —~~ J W Lawson

Platinized loops

Resistance of loops before being treated with platinum chloride measured over 1000 Ohms. After treatment the loops measured respectively 1000. 590 and 350 Ohms.

1/7/81 J.W.L.

4 carbons - 2 lamps of each

F.A.'s experiments

No. 1 - 1 Milligramme Napthaline crystals put in globe -

No. 3 - Piece of phosphorus, dried and size of birdshot, put in globe -

No. 4 - Piece of sodium size of birdshot put in globe -

No. 5 - 3 milligrammes crystals Trichloride carbon placed in globe

No. 6 - Platina wires and clamps coated heavily with shellac -

No. 7 - 3 Milligrammes Benzoic acid placed in globe -

1/11/81 –

Experiment No. 2

5 Milligrammes napthaline crystals dissolved in ½ Thimbleful gasoline – The inner surface of the lamp was then washed with this solution, the globe being heated before being washed. The lamp exhausted in reg. way –

No. 8a The lamp before being placed on pump was washed inside with strong sulphuric acid –

No. 8b. A piece of charcoal 3/16 in square was soaked in melted napthaline crystals then placed in lamp –
Lamp exhausted in reg. way

No-9 A piece of charcoal 3/16 in. square was heated until redhot and at red heat was plunged under the surface of mercury, removed and suspended in bottle containing strong ammonia but not in contact with the liquid after remaining in bottle 5 minutes it was placed in lamp - pump exhausted in reg- way —

1/13/81 - No 12 - Soaked 2 carbonized loops 2 hours in an alcoholic solution of shellac about as thick as that used for lacquering - They were then allowed to drip and dry 1½ hours; given to Neal who placed in furnace and subjected to same treatment as "reg"

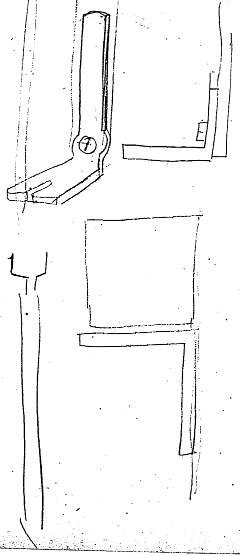
No. 12 1/[illegible] — The resistance of the loops before treatment with shellac measured:—

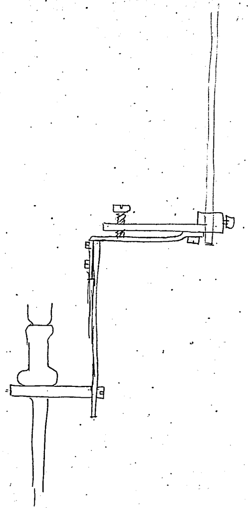
No. 1 — 215 Ohms — No. 2 — 221 Ohms

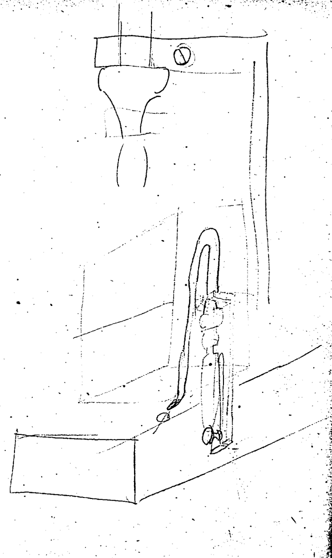
After treatment, they measured:—

No. 1 — 214 Ohms — No. 2 — 223 Ohms

The carbons not so black as before treatment with shellac varnish —







For Ag bath.

1 oz. Ag converted into ~~[illegible]~~ $Ag(CN)_2$

2 oz KCy dissolved in ~~[illegible]~~ c.c. H_2O or ~~[illegible]~~ " "

1250 c.c. H_2O

2
8a +
8b
8
9
6

~~When carbon is cold the deposit (principal part) is black~~

~~One of the clamps covered with iridescent deposit the other remaining bright Film on glass disappearing~~

~~No. 6 - Shellac 1/11/81~~

~~When raised to high incandescence - ~~the~~ characteristic bule made its appearance at ~~the~~ clamp. a deposit being formed on the inner surface of the globe in the near vicinity of the clamps (iridescent.) —~~

~~No. 8b_ When first brought up to high incandescence no change from reg - appeared but after remaining so a few minutes an iridescent deposit made its appearance on the inner surface of the globe very faint~~

No-8a - ~~Black~~ Iron grey deposit on clamps -

No-5 - ~~Faint~~ becoming stronger irridescent deposit on gen immediate vicinity of clamps -

No-8a - A few minutes after being raised to high incandescence a dark iron grey deposit forms on the clamps -

No-2 - Busted - fused platina wires, try again

Experiments on clamps - Binding the platinum wire to the carbon by electro-deposits of copper

After exhausting

and bringing to high incan-
descence There was found
to be on one of the clamping
ends of the carbon just above
the clamp a fluffy substance
Not a deposit but apparently
produced from the decomposition
of some substance in the carbon
Probably the carbons absorbed
a quantity of salt having
remained in the solution
so long a time —

No. 2 = Blue around clamp
clamp around which blue
appears is blackened —

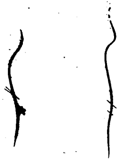
Nos- 8a ~~Both broken at curve of carbon- The carbon being split into shreds~~

Out-

~~1/12/81 -~~ ~~[illegible]~~ 1.45 - P.M-

No 9 - Brought up to high incandescence - one clamp immediately coated with an iridescent film 1.50 P.M-

By raising still higher the film on clamp disappears and characteristic blue makes its appearance at clamp - which ~~film~~ ~~[illegible]~~ was coated with film -



1/2/81 - 3 P.M. -

Portion of [illegible] stem coated with yellowish film - Perhaps substance which was on lamp -

8th Mercury got into globe and of course the conditions of experiment were altered so try this again -

[ITEM FOUND IN BOOK]

Experiments Tried.

[ITEM FOUND IN BOOK]

(1) 1/4/81 –

Bk. 2: pg. 3

Platinized Carbons
(High resistance loops)

Place the carbon loops in a boiling aqueous solution of platinum chloride, in which they are to remain 15 minutes, the solution being kept at the boiling point all the time – They are then to be taken out and dried at a temperature of 75° C.; then placed in lamp and treated in regular way :– or, after boiling in solution and drying in oven, they are to be taken to Neal who will subject them to same ~~treatment~~ that he does the regulars, after this boil again in platinum chloride and again heat in furnace; if, after each platinization the

[ITEM FOUND IN BOOK]

resistance of the carbons
is lowered; continue the
~~treatment~~ until the resis-
tance is as low as the regul.
[Bk-2: pg. 381]

11/7/81—
A' carbons — 2 lamps of
each—

(2) No-1— 1 Millegramme
napthaline crystals put in
globe — ~~then~~ treated in
regular way—

(3) No. 3— Piece of phosphorus
dried and size of bird shot
put in globe— Treat in
reg. way—

(4) No. 4— Piece of sodium,
dried, size of bird shot put
in globe— Treat in reg. way

(5) No. 5— 3 millegrammes
crystals trichloride carbon
placed in globe— Treat in
reg. way— [Bk-2: pg. 5]

(6) No. 6— Platina wires and
clamps to be coated heavily
with shellac— Treat in "reg." way— [Bk-2: pg. 3]

(7) No. 7— 3 millegrammes
benzoic acid placed in globe—
Treat in "reg." way—

(8) 1/11/81— No. 2—
5 millegrammes napthaline
crystals dissolved in ½ thimble-
ful gasolene— The inner
surface of the globe to be
washed with this solution,
the globe being heated before
washed— Treat in "reg." way—
[Bk. 2: pg. 588]

[ITEM FOUND IN BOOK]

6

(9) No. 8a— The lamp before being placed on pump to be washed inside with strong sulphuric acid— Treat in "reg" way— [Bk. 2: lf. 4]

(10) No. 8b— A piece of charcoal 3/16 in. square to be soaked in napthaline crystals then placed in lamp— Treat in "reg" way— [Bk. 2: lf. 4]

(11) No. 9— A piece of charcoal 3/16 in. square to be heated until redhot in flame of spirit lamp then plunged under the surface of mercury, removed and suspended in bottle containing strong aqua ammon but not in contact with the liquid, after remaining in bottle 5 minutes it is to be placed in lamp— Treat in "reg" way— [Bk. 2: lf. 6]

(12) 1/13/81— No. 12—

Soak two (2) carbonized loops 2 hours in an alcoholic solution of shellac about as thick as that used for lacquering— They are then allowed to drip and dry 1 1/2 hours; given to Neal to place in furnace and subject to same treatment as "reg" [Bk. 2: lf. 7]

[ITEM FOUND IN BOOK]

1/13/81—

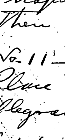
(13) Experiments on clamps
Binding the platinum wires to the carbons by means of electro deposits — Bk.2:p.7

1/15/81 —

(14) — No. 10 —
Clean the globe inside with wood naphtha (pyroxylic spirit) and then exhaust — Bk.2:p.8

(15) No. 11 —
Place in the lamp 10 milligrammes of gum kino

(16) No. 106 —
3 regular lamps with tube



Fill with phosphorus anhydride, tube No. 1,
fused, caustic potash " " 2,
with sulphur " " 3,
manipulate the carbons in reg. way — Don't heat 1, 2 or 3 —

1/16/81 —

(17) — Prepared a solution to try to deposit platinum by electro means — A solution of platinum bichloride was precipitated with ammonium chloride and the precipitate well washed with alcoholic water, then a small quantity of water added to it and a few pieces of caustic potassa thrown in, this was then added to a strong solution of potassium cyanide at a temperature of 100 C., the whole was then boiled until all ammoniacal fumes had stopped being given off from the solution Bk.2:p.9

[ITEM FOUND IN BOOK]

1/16/81

(18) - To the solution of (17) was added some pieces of solid platinum bichloride and then heated until the precip formed had disappeared —

Bk. 2 : p 49

(20) New style clamps — 1/15/81 —
Clamping by electro-deposition —

#1 - A^s Placed in solution 3 - P.M. 1/16/81
Taken out " 10 - P.M. 1/17/81 -
Plated with copper —
In circuit of 1 Daniel's cell —

(20)

#2 - A^s Placed in solution 11.30 A.M. 1/8/81
Taken out " 9. A.M. 1/10/81
With copper
1 Daniels —

#3 - B^s (3) - Placed in solution 8 - P.M. 1/16/81 -
Taken out " 1:30 P.M. 1/17/81 -
With copper,
1 Daniels

#4 - Spiral (1)
Placed in solution 8. A.M. 1/18/81 -
Taken out " 9: A.M. 1/18/81 -
With copper
1 Daniels

#5 - B^s (7) -
Placed in solution 2 - P.M. 1/17/81 -
Taken out " 2 P.M. 1/18/81 -
With silver
1 Daniels

#6 - B^s (4)
Placed in solution 5 - P.M. 1/17/81 -
Taken out " 5 P.M. 1/18/81 -
With copper —
1 Daniels through 30 Ohms —

[ITEM FOUND IN BOOK]

 (20)

#7. Spiral (1)
Placed in solution 9 A.M. 1/18/81 -
Taken out " 9 A.M. 1/19/81 -
With copper.
1 Davis - 20 Ohms -

#9. Spiral (1)
Placed in solution 3 P.M. 1/18/81 -
Taken out " 9 A.M. 1/19/81 -
With copper
1 Davis. 20 Ohms.

#10. B's (4).
Placed in solution 9 P.M. 1/18/81
Taken out " 11 A.M. 1/19/81 -
with copper
1 Davis - 30 Ohms.

#8. B's (6).
Placed in solution 2 P.M. 1/18/81.
Taken out " 11:30 A.M. 1/19/81 -
With silver
1 Davis. 20 Ohms.

1/20/81

#11 Spiral (1)
Placed in solution 10 A.M. 1/19/81
Taken out " 2 P.M. 1/20/81 -
1 Davis. 20 Ohms. With copper

(20)

1/20/81 -

#12. B's (5) -
Placed in solution 3:30 P.M. 1/19/81
Taken out " 4 " 1/20/81 -
With silver
1 Davis - 20 Ohms -

#13. B's (4)
Placed in solution 5:30 P.M. 1/19/81 -
Taken out " 4:30 " 1/20/81.
With copper
1 Davis - 30 Ohms.

#14. Spiral (1) -
Placed in solution 8 P.M. 1/19/81
Taken out " 10 A.M. 1/20/81 -
Replaced in " " "
Taken out " 10 P.M. "
With copper
1 Davis. 30 Ohms.
Bk. 2, p. 10 -

1/22/81 -

#15. 2 Spirals -
Placed in solution 3:30 P.M. 1/20/81
Taken out " 2:30 " 1/22/81
1 Davis - 20 Ohms. With copper

[ITEM FOUND IN BOOK]

 (20)

#16 - 1 Spiral -
Placed in solution 9 P.M. 1/20/81
Taken out " 2:30 " 1/22/81 -
With copper
1 Dan's - 20 Ohms

1/24/81 -

#17 - ~~2~~ B^s
Placed in solution 10 P.M. 1/20/81 -
Taken out " 1 " 1/22/81 -
With silver
1 Dan's. 30 Ohms

1/25/81 -

#18 - 1 Spiral -
Placed in solution 4:30 P.M. 1/24/81 -
Taken out " 8:30 A.M. 1/25/81
With copper
1 Dan's 20 Ohms.

#19. 4 A^s 1/26/81 -
Placed in solution 2: P.M. 1/25/81 -
Taken out " 8: A.M. 1/26/81 -
Cu
1 Dan's, 30 Ohms

(20)

1/27/81 -

#20 - 4 A^s -
Placed in solution 3: P.M. 1/26/81 -
Taken out " 8: A.M. 1/27/81 -
Cu
1 Dan's. 20 Ohms

#21 - 1 Spiral -
Placed in solution 9 A.M. 1/27/81
Taken out " 4:30 P.M. 1/27/81
Cu
1 Dan's 20 Ohms

1/28/81 -

(27)

Order -
Make two lamps, regulators, ects, but carbons coated with Alumina, Zirconia ect.

✓ No. 108 - Coate the carbon with Alumina

✓ No. 110 - With Magnesia -

✓ " 111 - Strontia

[ITEM FOUND IN BOOK]

16 No. 112 — With Silica —
" 113 " Zirconia
" 114 " Cerium oxide

These oxides were taken and a ~~[illegible]~~ thick paste in ether made with each, then the entire carbon was coated with this paste, by means of a camel's hair brush.

Menlo Park Notebook #171 [N-80-10-12]

There are no dated entries in this notebook with the exception of one entry for October 12, 1880. The entries are by Francis Upton and Francis Jehl and consist of rough notes and calculations relating to lamp tests from Lots 1 and 2. There is also a table of lamps in Lot 2. The label on the front cover is marked "Lot 2 of 100" and "Oct 1880 F R Upton." The book contains 284 numbered pages. Approximately half the pages have been used.

No. 1 taken off 3-37 to measure 36 candles

put back at 3-50 minutes

$$\frac{37}{-13}$$

-13

6-50 A.M. 203 minutes

$$\begin{array}{r} 153 \\ 50 \\ \hline 203 \\ 13 \\ \hline 190 \end{array}$$

Taken off

-15

8000
65.75
142.5

1335
2
3070

1.8178
2
3.6356
2.3070
1.3286

154
2
308

21.4
2
42.8 candles

Went 10-19 A.M.

388
19
407
15
392

A.M. 5-20 Went

20
60
33
113 minutes

93
20
113

3-43 a.m. Went
16 minutes

11-48 A.M

$$\begin{array}{r} 448 \\ 48 \\ \hline 496 \end{array}$$

2-40 P.M

$$\begin{array}{r} 40 \\ 568 \\ \hline 608 \end{array}$$

5-28 A.M

$$\begin{array}{r} 93 \\ 28 \\ \hline 121 \end{array}$$

AM 8-52

$$\begin{array}{r} 273 \\ 52 \\ \hline 325 \end{array}$$

~~25~~-15 AM ~~and~~ went

$$\begin{array}{r} 60 \\ 33 \\ 15 \\ \hline 108 \end{array}$$

$$\begin{array}{r} 93 \\ 15 \\ \hline 108 \end{array}$$

A.M. 4-12 went

$$\begin{array}{r} 42 \\ 3 \\ \hline 45 \end{array}$$ minutes

$$\begin{array}{r} 33 \\ 12 \\ \hline 45 \end{array}$$

4-37 a.m.

$$\begin{array}{r} 37 \\ 33 \\ \hline 70 \end{array}$$

$$\begin{array}{r} 33 \\ 37 \\ \hline 70 \end{array}$$

7-47 a.m

$$\begin{array}{r} 213 \\ 47 \\ \hline 260 \end{array}$$

The following marked
on inside front cover

went at
84 — 5.40 P.M.
57 — 5.43 "
36 — 5.43 "
98 — 5.48 globe very blue
83 — 5.50 in glass

87 — 5.55
40 — 7.12

4-57 A.M 80

6/8 3

/9 9

57

33

90

4-52 P.M.

688

52

740

Gone 1-15 P. M

15
508
523

6-18 Am
153
171

15

9-35 AM

$$\begin{array}{r} 333 \\ 35 \\ \hline 368 \end{array}$$

1-15 P.M. 504
15
527

6-50 A.M.

203 minutes

9-40 AM. ~~303~~

$$\begin{array}{r} 333 \\ 40 \\ \hline 373 \end{array}$$

4-20 A.M.

33
20
53

Gene 9-45

333
45
378

5-45 A.M.

$$\begin{array}{r} 45 \\ 93 \\ \hline 138 \end{array}$$

5-45 A.M.

$$\begin{array}{r} 45 \\ 93 \\ \hline 138 \end{array}$$

9-28 A.M. $\begin{array}{r} 333 \\ 28 \\ \hline 361 \end{array}$

11-25 AM - 448

$$\begin{array}{r} 448 \\ 25 \\ \hline 473 \end{array}$$

A.M. 5-26 Went

$$\begin{array}{r} 26 \\ 93 \\ \hline 119 \end{array}$$

66 [illegible]

6-50 A.M. 153
50
203 minutes 207

8-21 A.M. 273
21
294

7-30 A.M.

$$\begin{array}{r} 240 \\ 3 \\ \hline 243 \end{array} \qquad \begin{array}{r} 213 \\ 30 \\ \hline 243 \end{array}$$

7-1 A.M.

$$\begin{array}{r} 180 \\ 33 \\ \hline 213 \\ 1 \\ \hline 214 \end{array}$$

6-16 A.M.

$$\begin{array}{r} 153 \\ 16 \\ \hline 169 \end{array}$$

8-08 a.m.

$$\begin{array}{r} 240 \\ 33 \\ \hline 273 \\ 8 \\ \hline 281 \end{array}$$

2-26 P.M.

$$\begin{array}{r} 568 \\ 26 \\ \hline 594 \end{array}$$

6-27 A.M.

$$\begin{array}{r} 153 \\ 27 \\ \hline 180 \end{array}$$

6-24 A.M.

$$\begin{array}{r} 24 \\ 153 \\ \hline 177 \end{array}$$

4-47

47
33
86

Went at 4-23

$$\begin{array}{r} 33 \\ \underline{23} \\ 56 \end{array}$$

Went at 3-33 A.M.
6 minutes

11 — A. M.

448

Went at 4-8 A.M.

$$\begin{array}{r}38\\3\\\hline 41\end{array}$$ minutes

$$\begin{array}{r}38\\3\\\hline 41\end{array}$$

Lamp 53 taken at 9-45
and found to be 48 candles
at 10-5 it was brought
to 68" on bar impossible

68 34 17
12 6 3

$$\begin{array}{r}34\\34\\\hline 136\\102\\\hline 1156\end{array}$$

$$\begin{array}{r}17\\17\\\hline 119\\17\\\hline 289\end{array}$$

$9\overline{)289}$

32
2
64 candles

Kept in Photometer room

A.M. 6-9 went

$$\begin{array}{r} 93 \\ \underline{60} \\ 153 \\ \underline{9} \\ 162 \end{array}$$ minutes

5-33 Taken down stairs to test

5.43 brought — -16

66."875

3-55 P.M.

$$\begin{array}{r} 628 \\ \underline{45} \\ 673 \end{array}$$

$$\begin{array}{r} 55 \\ \underline{10} \\ 45 \end{array}$$

~~[illegible]~~
5-38 A.M.

$$\begin{array}{r} 93 \\ 38 \\ \hline 131 \end{array}$$ minutes

$$\begin{array}{r} 93 \\ 38 \\ \hline 131 \end{array}$$

5-41 A.M 93

$$\frac{\begin{array}{r}41\end{array}}{134}$$

5-39 A.M

$$\begin{array}{r}93\\37\\\hline 130\end{array}$$

A.M 4-35 Went

$$\begin{array}{r} 35 \\ 33 \\ \hline 68 \end{array}$$

5-43 A.M

$$\begin{array}{r} 33 \\ 93 \\ \hline 126 \end{array}$$

at 9-17 took down to test

9-30 brought back -13

3-15 P.M.

15
13

2
628
---
630 minutes

1-22 P.M.

508
22

5?6

9-35 AM

333
35
368

5-41 Am

41
93
134

6 [illegible]

$$\begin{array}{r} 60 \\ \underline{93} \\ 153 \end{array}$$

[illegible]

[illegible]

6-23 A.M.

$$\begin{array}{r} 153 \\ 23 \\ \hline 176 \end{array}$$

7-25 P.M

180
33
25
238

213
25
238

9-7 AM

$$\begin{array}{r} 333 \\ 7 \\ \hline 340 \end{array}$$

8-4 AM

$$\begin{array}{r} 240 \\ 33 \\ \hline 273 \\ 4 \\ \hline 277 \end{array}$$

[illegible]

22
370
12
404

Did not go

5-30 A.M. Went ~~[illegible]~~

93
30
123

Burnt resistance at 1-58 and relit itself

P.M. 2-4 Went

568
4
572

6-5.0 AM

$$\begin{array}{r} 15\text{-}3 \\ 5\text{-}0 \\ \hline 20\ 3 \end{array}$$

started at 6 again

3-47 a.M Went

20 minutes

4-32 A.M

60
2
3
65

33
32
65

5-51 A.M. 93
57
144 c

Went 4-47 Am

33
47
80

4-45 went

45
33
78

8-22 ~~a~~.m.

$$\begin{array}{r} 273 \\ 22 \\ \hline 295 \end{array}$$

4-30 Taken to measure
15 candles by photometer
4-40 replaced

p.m 4-30 Taken to measure
4-48 returned
19 candles

AM 4-40 went

$$\begin{array}{r} 40 \\ 33 \\ \hline 73 \end{array}$$

5-45 Went

93
45
138

AM 3-5 7 Broke

30 minutes

10-21

$$\begin{array}{r} 273 \\ 21 \\ \hline 294 \end{array} \qquad \begin{array}{r} 383 \\ 21 \\ \hline 404 \end{array}$$

10-55

$$\begin{array}{r} 383 \\ 55 \\ \hline 438 \end{array} \qquad \begin{array}{r} 383 \\ 55 \\ \hline 438 \end{array}$$

P.M.

5 - 35

$$\begin{array}{r} 688 \\ 35 \\ \hline 723 \\ 60 \\ \hline 783 \end{array}$$

Taken off 4-5
put back 4-20 — 15
Very high
80 candles

10-8. Went

$$\begin{array}{r} 383 \\ 15 \\ \hline 368 \\ 8 \\ \hline 376 \end{array}$$

5-5 A.M.

93
5
96

4-1 A.M.

34 minutes

6-22 Am

$$\begin{array}{r} 153 \\ 22 \\ \hline 175 \end{array}$$

5-27 went
Am

$$\begin{array}{r} 93 \\ 26 \\ \hline 119 \end{array}$$

6-28 A.M.

$$\begin{array}{r} 153 \\ 28 \\ \hline 181 \end{array}$$

$$\begin{array}{r} 60 \\ 60 \\ 33 \\ \hline 153 \end{array}$$

4-16 broke

$$\begin{array}{r} 30 \\ 16 \\ 3 \\ \hline 49 \end{array}$$

508 at 1 P.M.
300
808 at 6. P. M.

8

12 Oct 80

Started at 2- 5 A.M.
Light red

At 2-42 About 16 candles

The belts were loose and slipped.

At 3 A.M started at 48 candles

3-02 stopped

At 3-10 A.M. began again
" 3-11 " Stopped
" 3-30 " Started 3 minutes
Stopped 5 minute to change machines
Stopped 12-10

Lamps 46 ✓ 808 minutes
-70 ✓
-84 ✓ 813
-57 ✓ 816
-36 ✓ 816
-98 ✓ 821
-83 ✓ 823
~~87 828~~ ✓

-40 845

-67 903
-29 913
-37 919
-42 925
-43 940
-53 970
-22 1130
-69 1182
-18 1220
-13 1315
-51 ✓ 1355

18 | 200 (1 19
16
140

808 minutes
535 started
600 stopped 25
833
7-5 a.m. started 60
890
950
1070
120
2 P.M 1190
120
4 P.M 1310
5 P.M 1370

202
202
404
134

135 : 161 :: 148 ;

25150
4500
29650
148.25

2068
1703
8697
2468

177
148
29

135 ; 156 :: 148

1931
1703
8697
2331

171
148
+ 23

1303
1303
6464
8297
7367

5450

Test of the Lamps 103
That were on the table
and burning some
time.

Francis Jehl

No 53 Fat no 2

Emf 202 - 202 135 Volts. 148 Ohms
R $\frac{25150 + 4500}{200}$
c 48

Emf 170 170
R $\frac{25150 + 6200}{200}$
C 16

215
215
430
143

314
15
329
164

1931
2146
8447
2526

179
164
+13

1553
1553
8069
6464
7639

5800 ft

EMF 215 – 215 143 Volts

R $\frac{31400 + 1500}{200}$ 164 Ohms

C 48

EMF 185 – 185

R $\frac{31400 + 2900}{200}$

C 16

JC

1406
135

314
7
321
160

~~437~~
~~286~~

~~587~~

.8069
1303
7932
7304
2696

148 : x ::

135 : 156 :: 148 : X

$$X = \frac{148 \times 156}{135} = \frac{1.48 \times \frac{1}{135}}{\frac{1}{156}}$$

$$\frac{1}{X} = \frac{1351}{148 \times 156}$$

186
161
+ 25

1303
1303
.6464
7932
6602

4580

Ammt	203 - 203	135 Volts
R	$\frac{31400 + 700}{200}$	161 Ohms
C	48	
Ammt	189 - 189	
R	$\frac{31400 + 2004500}{200}$	
C	16	

(434
144.6

No 46 no 2

Elu7	217—217	144.6
R C	It went up about ~~five~~ (two) minutes afterwards. broke at the clamps	

(410
133

2515
42
(2935
1467

1931
1673
876.0
2364

172
147
+ 25

8240
1240
8326
6464
7270

5.330

Lo 5 1 no 2

Emf	205 – 205	133 Volts
R	$\frac{25150 + 4200}{200}$	147 Ohms
C	48	
Emf	175 – 175	
R	$\frac{25150 + 5700}{200}$	
C	16	

4470
156

376.5
7
3835
196.7

1931
2945
8069
2945

197

1931
1931
7655
6464
7381

5470

No 18 No 2

EMF	235-235	156 Volts
R	$\frac{37650 + 700}{200}$	197 Ohms
C	Blue at the Clamp	
Curt	208 - 208	
R	$\frac{37650 + 3000}{200}$	
C		
	Blue at the Clamp	

$\frac{400}{137}$

2515
59
3105
155.2

1931
1903
8761
2595

181
155
+ 26

1239
1239
8097
6464
7039

5050

No 40 Lat 1

Emf	200 — 200	133 Volts
R	$\frac{25150 + 5900}{200}$	155.2 Ohms
C	48	505.0
Emf	170 — 170	
R	$\frac{25150 + 7700}{200}$	
C	16	

430
143

314
43
357
178

1931
2504
8447
2882

194
178
16

1553
1553
7496
6464
7066 5090

No 1 Lot 1

Curt	215 – 215	143 Volts
R	$\frac{31400 + 4300}{200}$	178 Ohms
C	48	
Curt	190 – 190	
R	$\frac{31400 + 5900}{200}$	
C	16	

$$\frac{1484}{161}$$

37650
1600

$$\frac{39250}{196}$$

2068
2068
6464
7077
7677

5850

(931)

13. Lat 2

Emf 242 — 242 161 Volts

R $\dfrac{37650 + 1600}{200}$ 196 Ohm

5850 ft lbs

C 48

Blue at the clamps

Emf 218 — 218

R $\dfrac{37650 + 3300}{200}$

C 18

440
146

25150
3000
28150
140.7

2 1644
2 1644
1 6464
7.9518
3.9270

8450 ft. lbs

1931
1482
8356
1769

150
140.
+ 10

No 22 No. Lt 2

Emf ~~28~~ 220 - 220 147 Volts

R $\frac{25150 + 3000}{200}$ 140.7.

C 48 Blue at the clamp

Emf 192 - 192

R $\frac{25150 + 4500}{200}$

C 16

25150
2300
27450
137

205
2
410
137 Volts

1931
~~1367~~

156
137
+ 19

1367
6464
7831

6060

No 67 Lot 2

CAMF	205 - 205	137 Volts
R	$\frac{25150 + 2300}{200}$	137 Ohms
C	48 Blue at the clamps	
CAMF	175 - 175	
R	$\frac{25150 + 4200}{200}$	
C	16	

140

314
18
332
166

1931
2201
8539
2671

185
166
+19

1461
1461
6464
7799
9185

5220

Ckt 210 — 210 1.40 Volts

R $\frac{31400+1800}{}$ 1660 Ohms

C 48

Ckt 179 — 179

R $\frac{31400 + 2800}{200}$

C 16

197
197
1394
131

25150
2700
27850
139.25

1931
1434
8827
2192

165
139
+26

1173
1173
8566
6464
7376 5460

No 69 no 2

Eut 197 – 197 131 Volts

R $\frac{25150 + 2700}{200}$ 139.25

C 48

162 – 162

Eut

R $\frac{4400 + 25150}{200}$

C 16

220
221
441
·147

314
52
366
183

1931
2625
8356
2912

195
183
+12

1644
1644
7375
6464
7127

5160

Emf	220 – 221	147 Volts
R	$\frac{31400 + 5200}{200}$	183 Ohms
C	48 Blue at the clamp	
Emf	193 – 193	
R	$\frac{31400 + 7400}{200}$	
C	16	

223
446
149

314
34
348
174

1931
2405
8268
2604

182
174
8

1732
1732
7594
6464
7522

5650

Tio ~~3~~ 88 lot 1

EM7	223 - 223 149 Volts
R	$\frac{31400 + 3400}{200}$ 174 Ohms
C	48 Blue at the Clamp
EM7	195 - 197
R	$\frac{31400\ 5700}{200}$
C	16

No 70 Rot 2

Cut R C	went up at the Clamp.
Cut R C	

235
232
467
156

2 2550
12
314
30
344
172

1931
2355

1931
1931
6464
7645
7971

6260

Emf	Bad spot on the side 235 - 232 156 volts
R	$\frac{31400 + 3000}{200}$ 172 ohms
C	48 Blue at the Clamp.
Emf	198 — 198
R	$\frac{5600 + 31400}{200}$
C	16

418
139

2515
23
2745
137.2

1931
1367
8570
~~1~~866

153
137
+16

1430
1430
8633
6464
7957

6240

98

no 2

Elec 7	209 - 209	139 Valts
R	$\frac{25150 + 2300}{200}$	137 Ohms
C	48	
Elec 7	182 - 182	
R	$\frac{4900 + 25150}{200}$	
C	16	

450
150

314
15
329
164

1931
2148
8239
2318

171
164
+7

1761
1761
7852
6464
7838

6070

No. 42 Lot 2

Em7	225 - 226
R	$\frac{31400 + 1500}{200}$
C	48 Blue at the clamp.
Em7	196 - 195
R	$\frac{31400 + 3400}{200}$
C	16

150 Volts
164 Ohms

72.6
2
1552

314
2
316
158

1931

+ 1

1903
1903
6464
8013
8283 6730

No 36 [illegible]

Curr	218 – 218		155 Volts
R	$\frac{31400 + 200}{200}$		158 Ohms
C	48		
Curr	185 – 185		
R	$\frac{2000 + 31400}{200}$		
C	16		

1427
142

319
159

1931
2014
8477
2422

175
159
16

1523
1523
7986
6464
7496

5620

43 Bat 2

Em7 212 — 245 142 Volts

R $\frac{31400 + 500}{200}$ 159 ohms

C 48

Em7 180 — 180

R $\frac{31400 + 2000}{200}$

C 16

428	314
143	5
	319
	159

1931
2014
8447
2392

173
159
+ 14

1553
1553
7986
6464
7506 5630

Emf 214 - 214 143 Volts

R $\frac{31400+500}{200}$ 159 ohms

C 48

Emf 185—185

R $\frac{31400+2500}{200}$

C 16

R

$\boxed{440}$
147

314
15
$\boxed{329}$
164

1931
2148
8327
2406

174
+10

1673
1673
7852
6464
7662

5640

No 37 Lot 2

Curt. ~~240 — 242~~ 220 – 220
147 Volts

R $\dfrac{31400 + 1500}{2000}$ 164

C 48

Curt 187 – 187

R $\dfrac{31400 + 3200}{2000}$

C 16

25.1.5
37
28.85
144.2

1931
1584
8539
2054

161
144
+17

1461
1461
8416
6464
7862

6030

No 91   Bot 1

EMF 210 210   140 Volts

R $\frac{25150 + 3700}{200}$ 144.2 Ohms

C 48

EMF 178—176

R $\frac{25150 + 300}{200}$

C 16

Blackened globes 7. a. m Saturday

37

40

43

51

53

67 very slightly

69 sligt

---

91 brighter Dang

31400
35700
20 | 37100
3 | 371 | 183
123

314
456
2 | 770 | 385
182
18
3 | 200
66

192
193
3 | 385
128

3 | 360
120

182
182
3 | 364
121⅓

178
177
3 | 355
118

183
3 | 368
122

180
180
3 | 360
120

3 | 358
119

172
172
3 | 344
114

31400
4560
20 | 35960 (178
20
159
140
196
160
76

Lot No 2 — 16 Candle power.

No	Ohms	Volts	No	Ohms	Volts
1	183	127	18	179	123
2	163	118	19	174	124
3	192	128	20	165	117
4	168	123	21	179	144
5	157	115	22	148	116
6	174	121	23	163	182
7	172	120	24	172	130
8	171	119	25	~~n.g.~~	
9	181	120	26	150	118
10	185	124	27	190	134
11	185	127	28	176	124
12	159	116	29	176	118
13	168	120	30	163	123
14	177	136	31	194	137
15	168	113	32	163	120
16	152	109	33	172	117
17	194	130	34	191	129
	2949	2060	35	181	118
			36	190	126
				3124	2300

Average Ohms
172

Average Volts
119

2006
2900
1784
1905

67 | 7995 | 119
67
129
67
average for 67 lamps

625
603
22

Ohms
2934
3106
2698
2812
67 | 11550 | 172
Average for 67 lamps
85
469
160
134

2698
2812
2949
3126
66 | 11585 | 174 Ohms
66
498
462
265
264
1

1905
1784
2300
2060
66 | 8049
122 Volts.

See Page 201

Continuation of Lot 2 16 Candle

No.	Ohms	Volts	No	Ohms	Volts
37	178	116	53	162	113
38	244	140	54	187	123
39	167	117	55	172	115
40	168	113	56	184	120
41	153	115	57	187	121
42	154	112	58	177	120
43	173	119	59	179	117
44	183	120	60	178	123
45	162	111	61	182	127
46	166	119	62	165	113
47	206	124	63	194	132
48	181	118	64	too high not recorded	
49	very high not given		65	188	128
50	199	118	66	179	118
51	162	114	67	145	107
52	202	128	68	186	121
			69	147	107
	2698	1784	69 ~~66~~ lamps	2812	1905

/

Av. Volts – 122

Av. Ohms – 174

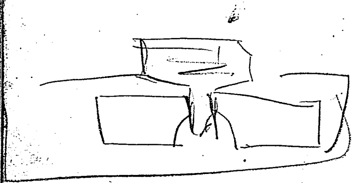
for 66 lamps

of lot 2

Em 7	R	Inant R	
1			
109	93	17	

Em7	R	Inant	
118	98	10	
118	117	12	
119	109	10	
119	102	9	

Em7	R.	Mutual R
121	108	8
121	122	9
125	114	5
121	112	8
120	112	9
120	116	9
122	107	6
121	117	9
121	104	7
126	123	4
128	117	2
128	135	2



1.2

133) 2111 (16
133
781

2111 8
44
133) 2155 (1.6
133
825
38

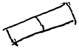
22

10 1.25
68

15
16

80 120

3 126.9
124



13) 2111

Menlo Park Notebook #172 [N-80-11-15]

This notebook covers the period October-December 1880. The entries are by Francis Upton. There is also one entry by Edison near the end of the book. The book contains notes, calculations, and a few drawings relating to lamp tests and to the wiring of the lamp factory. There are also notes and calculations regarding central stations, including estimates of costs and horsepower to be sold. In addition, there are notes, calculations, and a few drawings of isolated plants for the Vanderbilt home and for a building on 5th Avenue (probably the Edison Electric Light Company headquarters). The label on the front cover is marked "Upton" and "Calculations." The book contains 290 numbered pages.

Blank pages not filmed: 276-283, 286-287.

Jos Barr?
C/o Wm Porters Sons
#271 Pearl St
N.Y.

Arclamp The carbon in the clamp is estimated as being 3/16" long
0".102 wide
0".008 thick

for the two clamps this gives a cubical contents of 0.0003 cu in

If this absorbs 7.5 its ~~weight~~ bulk in air
0.00225 cu in

2352

3.3677
~~7.8861~~
8.3536
~~9.6074~~

3.3677
8.3536
2.1139

(3.8352

1.9176

82.7 Volts

The globe of a lamp holds 15.5 CC.

.061

15.5
930

9.455

.00225) 9.45500 (4202
900
455
450
500

12 Oct 3-30 A.M.

#~~2~~ 1 Blue [illegible] clasp

23

24

25

26

27

28

30

10 Blue 31

32

34

48

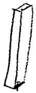
49

63

14 Blue 94

15

21



Let m = resistance of 1 inch $0''.001 \times 0''.001$ square

R = Resistance of a body

$a \times b$ = cross section

l = length

$$R = \frac{l}{ab} m, \quad m = \frac{abR}{l}$$

Surface = S

$$S = 2(a+b)l$$

Problem to find the dimensions of a carbon which shall have the same surface and k times the resistance.

Same candle power

$R' = kR$

$S' = S$

$R' = \frac{l'}{a'b'} m = kR$

$S' = 2(a'+b')l' = 2(a+b)l = S$

~~Let~~

$l' = g$ assumed

a' & b' = unknown

$a'b' = \frac{gm}{kR}$

$b' = \frac{gm}{a'pR}$

$S' = 2\left(a' + \frac{gm}{a'pR}\right) g$

$$a'pRS' = 2a'^2 pRg + 2g^2 m$$

$$S = S'$$

$$2a'^2 pRg - a'pRS = -2g^2 m$$

$$a'^2 - \frac{a'pRS}{2pRg} = -\frac{2g^2 m}{2pRg}$$

$$a'^2 - \frac{a'S}{2g} = -\frac{gm}{pR}$$

$$a'^2 - (\ ) + \frac{S^2}{16g^2} = \frac{S^2}{16g^2} - \frac{gm}{pR}$$

$$a' - \frac{S}{4g} = \pm\sqrt{\frac{S^2}{16g^2} - \frac{gm}{pR}}$$

$$a' = \frac{S}{4g} \pm \sqrt{\frac{S^2}{16g^2} - \frac{gm}{pR}}$$

$$b' = \frac{gm}{a'pR}$$

If $\frac{gm}{pR} > \frac{S^2}{16g^2}$

the result is impossible.

But if $\frac{gm}{pR} = \frac{S^2}{16g^2}$ or $< \frac{S^2}{16g^2}$

the problem can be solved.

$$\boxed{p = \frac{13}{16} = .812 \qquad \begin{array}{r} 1.1139 \\ 1.2041 \\ \hline 9.9098 \end{array}}$$

$m = 3966 \quad = 4000$

$R = 175$

$S = 300$

$g = 4$

$p = \frac{130}{175}$ $\qquad \begin{array}{r} 2.1139 \\ 2.2430 \\ \hline .8769 \end{array}$

$= .753 = \frac{3}{4}$

$$a' = \frac{S}{4g} \pm \sqrt{\frac{S^2}{16g^2} - \frac{gm}{\rho k}}$$

$$= \frac{300}{16} \pm \sqrt{\frac{90000}{256} - \frac{16000}{8392.5}}$$

16
16
96
16
256

4) 175
43.75
3
131.25

) 75
18.75

4.9542
2.1931
2.7611

4.2041
2.1179
2.0862

122
...5

) 265580
1.3290

18.75
15.
33.75

40.55

4.9542
2.4082
2.5460

352
122
230

) 3617
1.1808

151

175
130 $\quad$ 3/4 resistance

4/5 = 2/3 length

$$f' = \frac{gm}{a'\,pR}$$

$gm = 16000$
$pR = 130$
$a' = 15.1$

$$\frac{gm}{pR} = 122$$

$$\begin{array}{r} 2.0864 \\ 1.1790 \\ \hline .9074 \end{array}$$

$$\begin{array}{r} 8.08 \\ 33.75 \\ \hline 41.83 \\ 2 \\ \hline 83.66 \\ 4 \\ \hline 334.54 \end{array} \qquad \begin{array}{r} 17 \\ 8 \\ \hline 25 \\ 2 \\ \hline 50. \\ 6 \\ \hline 300. \end{array}$$

$$\begin{array}{r} 2.4771 \\ 1.3802 \\ \hline 1.0969 \end{array}$$

$$\begin{array}{r} 3.6 \\ 16 \\ \hline 216 \\ 36 \\ \hline 576 \end{array}$$

~~1.25~~

$$\begin{array}{r} 12.5 \\ 4.47 \\ \hline 8.03 \end{array}$$

$$\begin{array}{r} 4.9542 \\ 2.7604 \\ \hline 2.1938 \end{array}$$

156

$$\begin{array}{r} 156 \\ 136 \\ \hline 20 \end{array}$$

$$\begin{array}{r} 4.3764 \\ 2.2430 \\ \hline 2.1334 \end{array}$$

(1)3010

~~1.55~~

.6505

~~4.1~~

4.47

$g = 6$

$m = 3966$

$R = 175$

$S = 300$

$p = 1$

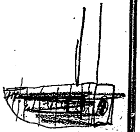
$$\begin{array}{r} 3966 \\ 6 \\ \hline 23796 \end{array}$$

$$a' = \frac{S}{4g} \pm \sqrt{\frac{S^2}{16g^2} - \frac{gm}{pR}}$$

$$= \frac{300}{24} \pm \sqrt{\frac{90000}{16 \times 36} - \frac{23796}{175}}$$

$= 8.03$

16.97



5-11-91

$$\begin{array}{r} 12730 \\ 2 \\ \hline 2.5460 \end{array} \qquad \begin{array}{r} 3966 \\ 4 \\ \hline 15864 \end{array}$$

$$\begin{array}{r} 4.2004 \\ 2.1179 \\ \hline 2.0865 \end{array} \qquad \begin{array}{r} 351.8 \\ 122 \\ \hline 229.8 \end{array}$$

$$\begin{array}{r} 2.3616. \\ \hline 1.1808 \end{array} \qquad \begin{array}{r} 18.75 \\ 15.15 \\ \hline 33.90 \end{array}$$

$$\begin{array}{r} 18.75 \\ 15.15 \\ \hline 3.60 \end{array}$$

$$b' = \frac{gm}{a' \, p R}$$

$$\begin{array}{r} 4.2804 \\ 8.4698 \\ 7.8861 \\ \hline .5563. \end{array} \qquad 3.6$$

$$a' = \frac{sS'}{4g} \pm \sqrt{\frac{s^2}{16g^2} - \frac{gm}{pR}}$$

$pR = R' = 130$

$m = 3966$

$s' = 300$

$g = 4$

$p = \frac{130}{175}$

$$a' = 18.75 \pm \sqrt{351.8 - 122}$$

$$\begin{array}{r} 33.9 \\ 3.6 \\ \hline 37.5 \\ 2 \\ \hline 75.0 \\ 4 \\ \hline 300.0 \end{array}$$

1.0969
2
2.1838

152
122
30

(1.4771
.7385

5.47
12.5
17.97

12.5
5.47
7.03

To change the surface

$S' = 200$

$$a' = \frac{200}{16} \pm \sqrt{\left(\frac{200}{16}\right)^2 - \frac{gm}{pr}}$$

$$a' = 12.5 \pm \sqrt{152 - 122}$$

50

0.″007 × 0.″018 × 6″.

$pr = R'$

$$\begin{array}{r} .8751 \\ 2 \\ \hline 1.7502 \end{array}$$

10''

$S' = 300$

$g = 10$

$m = 3966$

$pr = R' = 300$

$$a' = \frac{S'}{4g} \pm \sqrt{\left(\frac{S'}{4g}\right)^2 - \frac{gm}{pR}}$$

$$\frac{300}{40} = 7.5$$

$$\begin{array}{r} 17 \\ 8 \\ \hline 136 \end{array}$$

$$\begin{array}{r} 2.1335 \\ 2.1614 \\ 6.2218 \\ \hline .5167 \end{array}$$

3.286

$$S = 2(a+b)l$$

$$\begin{array}{r} 17 \\ 8 \\ 25 \\ 2 \\ \hline 50 \\ 6000 \\ \hline 300\,000 \end{array}$$

Lamp No. 67 of Lot 2
giving 16 candles ~~and~~
with a resistance of 145 Ohm
This lamp was made ~~of~~
the best bamboo ~~that~~ has
yet been found. Mr. B.
said that it was ab-
solutely without pith.
All linear measure-
ments in 0."001

$l = 6000$

$a = 17$

$b = 8$

$S = 300\,000$

$R = 145$

$$R = \frac{l}{ab}\,m$$

$$m = \frac{abR}{l} = 3.286$$

$\cancel{1}.0969$
2
2.1938   15.6

4.1189
2.1614
1.9575   156
90.7
65.3

1.8149
.9074   8.08

12.5
8.08
4.42
20.58

page 11

$$a' = \frac{S'}{4l'} \pm \sqrt{\left(\frac{S'}{4l'}\right)^2 - \frac{l'm}{R'}}$$

$S' = 200000$
$l' = 4000$
$m = 3.286$
$R' = 145$

3.286
4000
13 154.000

$\frac{\cancel{200000}^{100}}{\cancel{16000}_{8}} = 12.5$

$a' = 20.58$
$b' = 4.42$
25.00
2
50.0
4
200 O.K.

4.1189
2.1461
1.9728

156
~~9.39~~
93.9
62.1

1.7931
.8965

12.5
7.88
4.62

4.1189
2.1303
1.9886

20.38

156
97.4
58.6

12.5
7.65
4.85

1.7679
.8839

2013

4.1189
2.1139
2.0650

156
100
55

1.7464
.8702

12.5
7.42
5.08
19.92

Same values as on page 29
except $R' = 140$

$a' = 20.38$
$b' = 4.62$

$R' = 135$

$a' = 20.15$
$b' = 4.85$

$R = 130$
$b' = 5.08$
$a' = 19.92$

4.1189
2.0969
2.0220

2)1.7076
.8538

4.1189
2.0792
2.0397

1)1.6721
.8360

156
105
57

12.5
7.14
5.36
19.64

156
109
47

12.5
6.86
5.64
19.36

4.1189
2.0414
2.0795

1)1.5611
.7805

156
119.6
36.4

12.5
6.03
6.47
18.53

$R = 125$

$a'' = 19.64$
$b' = 5.36$

$R = 120$
$a' = 19.36$
$b' = 5.64$

$R = 115$

$R = 110$

$a' = 18.53$
$b' = 6.47$

156
131.5
24.5

$\frac{1.3892}{.6946}$

12.5
4.95
7.55

4.1889
1.9542
2.1647 12.5

156
146
10

3.16
9.34
15.66

$$\frac{gm}{pR} = \frac{\delta^2}{16g^2} \qquad \frac{\ell m}{R'} = \frac{S^2}{16\ell^2}$$

$$\frac{16\ell^3 m}{S^2} = R'$$

5.3010
16.6020

4000
4000
16000
4
64109
16
384
64
1.024

3.0103
0.5166
~~2.4937~~
9
~~11.4937~~

3.5269
1/2

~~11.4937~~
10.6020
12.5269
10.6020
1.9249

$R = 100$

$a' = 17.45$
$b' = 7.55$

$R = 90$

$a' = 15.66$
$b' = 9.34$

$R = 84.1$

$a' = 12.5$
$b' = 12.5$

2.3010
1.2553
11.0457
2
2.1914   123.5

D.5766
3.6532
4.1698   147.80
2.1614
2.0084   123.5
102
21.5

1.3324
.6662   11.1
4.64
15.74
6.46

4.1698
2.1761
1.9937   123.5
98.6
24.9
1.3962   11.1
.6981   4.99
6.11
16.09

$l = 4500$ $\frac{4500 \times 4}{18000}$

$S = 200000$

$m = 3.286$

$R' =$

$$a' = \frac{s'}{4l'} \pm \sqrt{\left(\frac{s'}{4l'}\right)^2 - \frac{l'm}{R'}}$$

$$\frac{200000}{18000} \quad 11.1 \pm \sqrt{123.5 - \frac{147.80}{R'}}$$

$R' = 145$

$a' = 15.74$

$b' = 6.46$

$R' = 150$

$a' = 16.09$

$b' = 6.11$

4.1698
2.2141
1.9657

123.5
92.4
31.1

1.4928
.7464

11.1
5.58
5.52
16.68

4.1698
2.2304
1.9394

123.5
87.
36.5

1.5623
.7811

11.1
6.04
5.06
17.14

4.1698
2.2553
1.9145
1.6160
.8080

123.5
82.2
41.3

11.1
6.43
4.67
17.53

R = 160

a' = 16.68

b' = 5.52

R = 170

a' = 17.14

b' = 5.06

R = 180

a' = 4.67

b' = 17.53

4.1698
2.1461
2.0237

123.5
105.5
18

1.2553
.6276

11.1
4.24
6.76
1534

4.1698
2.1303
2.0395

1.4461
.7230

123.5
109.5
14.0

11.1
3.74
7.36
14.84

4.1698
2.1139
2.0559

1.9956
.4978

1235
11.36
9.9

11.1
3.15
7.95
14.25

140 = R

a' = 15.34

b' = 6.76

R = 135 Ohms

a' = 14.84

b' = 7.36

R = 130 Ohms

a' = 14.25

b' = 7.95

4.1698
2.0969
2.0729

1235
11.83
5.2

1.7160
3580

11.1
2.28
8.88
13.38

4.1698
2.0792
2.0906

123.3

$R' = \frac{16 l^3 m}{S^2}$

3.6532
3
10.9596
1.2041
0.5166
4.6998
4.6990
22.0783

2.0783

$R = 125$

$a' = 13.38$
$b' = 8.88$

$R = 120$

$a' =$
$b' =$

$R = 119.7$ Ohms

$a' = 11.1$
$b' = 11.1$

$\mathcal{L} = 10000$

$\mathcal{S} = 200000 \quad m = 3.286$

$R = 250$

$$a' = \frac{S}{4l} \pm \sqrt{\left(\frac{S}{4l}\right)^2 - \frac{l^2 m}{R}}$$

$$\frac{200000}{40000} = 5 \pm \sqrt{25 -}$$

$a + b$

at

$a + b : a' + b' :: R : R'$

$$R' = (a' + b')\left(\frac{R}{a + b}\right)$$

$S = ab$

$ab : a'b' :: S : S'$

$$S' = \frac{a'b' S}{ab}$$

$$\begin{array}{r}17\\ 8\\ \hline 136\end{array}$$

$$\begin{array}{r}12\\ 12\\ \hline\end{array}$$

144 : 136 :: X : 165

2.1584
2.2175
7.8665

2.2424   1749

$$\begin{array}{r}17\\ 8\\ \hline 136\end{array}$$

136   2.1335
145   2.1614

4.2949

19700 2.1584

2.1365

$a+b : a'+b' :: S : S'$

$S' = \frac{(a'+b')S}{a+b}$ L = Constant

$ab : a'b' :: R' \; R$

$R' = \frac{ab\,R}{a'b'}$

$L = 6000 = L$

$S = 300$

$a+b = 25$

$a = 17$

$b = 8$

$R = 145$

$a = 16$

$b = 9$ $R = 137$

144

4.2949
2.1761
2.1188

4.2949
1875
.1074

2949
1931
1018

2949
1004
1945

12.5
12.5
2949
1938
1011

.0969
5
1938

2949
0569
2380

a' = 15
b' = 10
150

131 Ohms

a' = 14
b' = 11
14
14
154

128 Ohms

13
1.2
26
13
156

12.5 = a
12.5 = b

127 ohms
126.30 Ohms

18
7
126

157

19
6
114

173

20
5
100

197

$$\begin{array}{r} 1.0174 \\ \underline{2} \\ 2.0348 \end{array} \qquad \begin{array}{r} 2949 \\ \underline{0348} \\ 2601 \end{array}$$

$$\begin{array}{r} 2949 \\ \underline{0269} \\ 2680 \end{array}$$

$$\begin{array}{r} 2949 \\ \underline{0111} \\ 2838 \end{array}$$

$$\begin{array}{r} 2949 \\ \underline{9859} \\ 3090 \end{array}$$

$$\begin{array}{r} 2949 \\ \underline{9494} \\ 3455 \end{array}$$

$$\begin{array}{r} 2949 \\ \underline{8984} \\ 3965 \end{array}$$

6" carbon $l = 6000$

250 surface $s = 250000$

$\overset{6}{\cancel{300}} : \overset{5}{\cancel{250}} :: 12.5 : x$

$$\begin{array}{r} 12.5 \\ \underline{5} \\ 6\,)\,62.5 \\ \hline 10.416+ \\ \underline{10.416} \\ 20833 \end{array}$$

182 Ohms

$$\begin{array}{r} 11.83 \\ \underline{9.} \\ 106.47 \end{array}$$

185.4

$$\begin{array}{r} 12.83 \\ \underline{8.} \\ 102.64 \end{array}$$

192.1

$$\begin{array}{r} 13.83 \\ \underline{7.} \\ 96.81 \end{array}$$

~~204~~
203.8

$$\begin{array}{r} 14.83 \\ \underline{6.} \\ 88.98 \end{array}$$

22~~1~~.5

$$\begin{array}{r} 15.83 \\ \underline{5.} \\ 79.15 \end{array}$$

249.2

9202 / 2 = 1.8404

2949
8404
4545

2949
8203
4646

2949
8061
4888

2949
7659
5290

6" carbon — $l = 6000$

200 Surface — $S = 200000$

300 : 200 : 12.5 : X

$3\overline{)25}$ (× 2)

$X = 8.33$

$a = 8.333$

$b = 8.333$

9.666 × 7 = 67.666 — 284.7

10.666 × 6 = 63.999 — 291.5

11.666 × 5 = 58330 — 308.1

338.

15
15
75
15
225

$R = \frac{l}{ab} m$

3.6990
~~7.1031~~
6.5166
~~1.3187~~ ~~2.06~~
7.6478
1.8634 73

2.3522
4.2156
2.3502
8654

2156
3444
8712

2156
3345
9811

5" Carton $l = 5000$

$S = 300000$

5000) 300000 (60
75

$s = 2(a+b)\, l$

$a = b$

$4a^2 = \frac{s}{l}$

$a = \frac{s}{4l} = 15$

$a = 15$
$b = 15$

73 ohms

16
14
64
16
224

73.3

17
13
51
17
221

74.3

18
12
36
18
216

76.

2156
3201
8955

2156
3010
9146

2156
2765
9391

2156
2455
9701

2156
2068
9088

2156
1584
0572
2156
0969
1187

19
11
19
19
209 78.6

~~200~~
10
200 82.5

21
9
189 86.9

22
8
176 ~~117.5~~
93.3

23
~~7~~
161 102

24
6
144 114.1
25
5
125 131 Ohms

Length 5'' $\quad l = 50000$

Surface $= 250 = S = 250000$

$$S = 2(a+b)l$$

$$R = \frac{l}{ab}\, m$$

$a = b$

$$S = 4al \qquad a = \frac{S}{4l}$$

$$\frac{25\cancel{0000}}{2\cancel{0000}} = 12.5$$

2.0414
2.0414
1.6464
7.7930 5.7292
3.5222 3328
1.0792
2.4430 277

33000 4.5185
2.4430
2.0755 119

3.2 : $\frac{8}{3.25}$ :: 150

$\frac{8}{3.25}$ 3.2
65
675
5

16
Lamp 153 Ohms at 16 candle

110 Volts on line.

12 candles
154.5 Ohms 105.5 Volt

105.5 : 110 :: 154.5 :

2.1889
2.0414
7.9767
2.2070

161. ohms
154.5
6.5 Ohms

~~3500~~ 800
~~3200~~
~~12~~ 3

266

5.7292
~~7~~.7637 2355
3.4929 (3110
388

4.5185
2.5888
1.9297 8(85 candles per HP
10

5.7292
2.2926
3.4366 4(2730
682

4.5185
~~2.9455~~
~~1.5730~~ ~~(37~~
~~2.9455~~
~~4.5185~~ ~~9~~

4.5185
2.8338
1.6847 (48.8
12.2

8 candles

156.7 Ohms
100 Volts

100 : 110 :: 156.7
1567
172.37
156.7
15.6 Ohms

---

4 candles

161 Ohms
~~151~~3 Volts
90.3 : 110 :: 161
161
17710

4.2483
1.9557
2.2926

196
161
35 Ohms

166 ohms

82.6 : 110 :: 166

166
18260

~~4~~.2615
1.9170
2.3445

221
166
55 ohms

5.7292
2.3445
3.3847

2435 / 1217

4.5185
3.0856
1.4329

27 / 13.5

Lamp 6" X 0".012 X 0".012

16 candles 110 Volts

.115
3.4

$\bar{1}.0607$
0.4969
$\bar{1}.5576$

.361

Estimate for 10000 lamps fed from a central station each giving 16 candles

It is found that 8 of these may be obtained ~~of~~ from one horse power indicated

Say that a gas burner giving 16 candles consumes 5 feet of gas an hour for comparison

·200 hours for 1000 feet or 10000 lamps will consume 50000 feet an hour

Call ? ? in electricity an equivalent of a 1000 do

feet of gas an M (1)

50 M an hour

250 M a day

310 days in year in the district chosen

$$\begin{array}{r} 310 \\ 250 \\ \hline 15500 \\ 62 \\ \hline 77,500 \end{array}$$

~~M~~ feet a year

Old estimate

\$159.300 invested

$$\begin{array}{r} 5.2022 \\ 4.8893 \\ \hline .3129 \end{array}$$

\$2.05 investment per M.

at 8 per H.P. 10000 (1)
lamps will take 1250 H.P.
It is estimated that
1200 H.P. will be able to supply this amount.
This can be placed in
one building 25' X 100'.
The iron structure is
estimated in Book 100 p. 50
120.000 lbs of iron.
.05

$ 6000.00	$ 6.000
Foundation	2.500
Fire proof floors	2 000
	18,500

Boilers 600 H.P (1)

Babcock and Wilcox estimate, see letter.

600 H.P. boiler in place
with economizer $12,875
Stack 800
Steam pump 375
Blowers, 300
Engine with counter shaft 650
Piping 165
Ash elevator 400
Coal bunker 800

600 H.P. $16365

1200 H. P. Boilers (1)

Complete Boilers	$24,500
Stacks	1600
Steam Pumps	750
Blowers	600
Dynamos for Blowing	1000
piping	330
Ash Elevator	400
Coal bunker	1000
	$30180

Mr. K. estimates cost at

$$\begin{array}{r} \$\,4800 \\ 10 \\ \hline 48000 \end{array}$$

Extra Electrical apparatus
\$2000

lbs of H_2O in one Gall
= .16 Cu ft

795 9 6.25 Galls in Cu ft

6.25
10
62.5 lbs in Cu. ft.
100
6250 lbs. for 7.5 cts

.8779
3.7959
3.0820 .0012

.0012 cts per. lbs
30
.0360 cts per hour per H.P.

Total

(1)

Building	8500
Boilers	30180
Engines Dynamos	48000
Extra Electrical	2000
	88.680
	2000
	90680
Conductors	827 000
1750 Ohms lamp	[illegible]
Pipes	[illegible]
	57 000
	88 680
	145 680
	5 000
Meters	150 680
	2000
	152,680

85

48000
.03
1440.08

57600
.03
172800

365
20.5
1825
730
7482.5

Depreciation

Station

Boilers	10%	$ 3018
Building	2%	170
Engines Dynamos	3%	1440
[illegible] Electrical	[illegible]	40
Meters	5	250

Conductors

2% in whole 57000 .02 114000 1140

6058

365
5
- $ 1825

Labor

1 engineer, chief			5.00
1 Engineer			300
1 Wiper	@	1.50	150
1 head fireman	@	2.25	225
1 fireman	@	1.75	175
2 Laborers	@	1.50	300
1 Regulators	@	225	225
1 Regulator	@	1.75	175

assistg

20.50
365

Year 7482

Data

$200 per H.P. per year
~~[illegible]~~ delivered

Present machine $\overset{\text{cost}}{}$ $350.
good for 70 lamps

Conductors copper	27000
Pipes	25000
Insulation	5000
	$ 57000.

The labor account is taken thus a chief engineer who will be on duty from 12 M to 12 midnight an assistant who will be on duty from 12 mid-night to 12 M. a wiper who will be on duty from 7 a.m to 7 P.M.

One fireman @ $2.25 who will be on duty from 12 M to 12 midnight

One fireman @ $1.75 who will be on duty from 12 midnight to 12 M

One laborer from 7 am

to 7 P.M another
from 12 P.M to 12 midnight.
One regulator @ $2.25 from
12 M to 12 midnight one
@ $1.75 from 12 midnight
to 12 M.

Thus the cheif engineer will
be on duty during the
most important part of
the day, and the wiper will
be under each of the engineers.
The head fireman will
also be on duty ~~between~~ and have
5 & 6 P.M two laborers.
This system will offer
a good chance for promotions

$$\begin{array}{r} 365 \\ 365 \\ \hline 391\,5. \end{array}$$

2240) 18000 (8.03
17920
8000.

$$\begin{array}{r} 8.03 \\ 28 \\ \hline 6424 \\ 1606 \\ \hline 22.484 \end{array}$$

$$\begin{array}{r} 22.5 \\ 365 \\ \hline 1125 \\ 1350 \\ 675 \\ \hline 8212.5 \end{array}$$

daily

Executive expenses

Year $4000

Coal

$2.80 per ton delivered

3 lbs per H.P. per hour

$$\begin{array}{r} 1200 \\ 3 \\ \hline 3600 \end{array}$$ lbs per hour

$$\begin{array}{r} 5 \\ \hline 18.000 \end{array}$$ lbs per day

8.03 tons per day

$22.50 daily

$8212.5 year

15000
.02
300000

Lamps
30000 yearly
.35
30000
10,500

Oil, waste, water taken
as 1/3 coal
Yearly $ 2737.

Rent insurance Taxes $ 7.000

Summary

Depreciation	$ 6058
Labor	7,482
Executive	4,000
Coal	8.212
Oil-waste &c	2737.
Rent &c	7000
	$ 35489.
Lamps	10,500
	45.989

152.7) 1593 (104
152 7
6600
346
1693

9125) 45740 (50
45625
00115

Cost 50 cts per M

136875
68437
205312

91250
225
45625
18250
1825
205312

If 10000 lights can be sold for 5 francs daily ~~it~~ it is equivalent to 250,000 ~~cu. feet of~~ gas.

365
250
18250 ~~annually~~
.730
9125.0
1.50
456.2500
9125
Receipts 136875.00
Expenses 45989
$ 90.886 ~~left~~ to pay for patent rights and interest

$$\begin{array}{r|l} 1527 & 90845 \;(59 \\ & \underline{7635} \\ & 14490 \\ & \underline{13743} \\ & 7470 \end{array}$$

$$\begin{array}{r|l} 301.3 & 9088 \;(30\% \\ & \underline{9039} \\ & 49 \end{array}$$

(1)

If company capitalizes at twice the cost of plant $150680

$$\begin{array}{r} 150680 \\ \underline{2} \\ 301,360 \end{array}$$

The receipts will pay a dividend of 30 per cent.

60% on investment.

72) 72

Now for estimate under worst conditions and giving all margins.

6 per H.P.

2½ hours a day

Machine for 72 lights to cost ~~tw~~ $500

Belts &c 100

Building ~~double~~ ½ again as much ~~again~~

219 hours per lamp

Conductors $80,000

Coal $5.00 per ton

1200 H.P.

7200 lights

Investment

Structure	10500 5258 15750	$ 15750
Boilers		30,180
Engines		24,000
Dynamos 100		50,000
Belts &c		10 000
Conductors		80 000
Extra Elec		2 000
Meters		5 000
		216930

12750
.02
255.00

Worst,

Depreciation

Structure	2%	$ 355
Boilers	10	3018
Engines	3	720
Dynamos	3	1500
Belts	5	500
Conductors	2	1600
Extra Elec	2	40
Meters	5	250
		$ 7943

Labor	$ 7482
Executive	4000
Coal	8796
Oil waste &c	2932
Rent &c	10000
Lamps	10 500
	$ 51653

Five hours use

all items expense same except Coal & water & Lamps

	51653
Coal &c	8796
	2932
$	63381
Lamps	10.500
	73881

Receipts

49.275
2
98550
73881
24669 profit

Coal

Is taken as three hours daily to supply 2 1/2 hours

1200 H.P.
9 lbs per H.P. per day

2240) 10800 (4.82 tons
8960
18400
17920
4800

say

4.82
5
2410
365
1205
1446
723
$ 8796.50 yearly

2089) 547.0 (2.6
4178
1292

208.9) 17100.0 (8.2
16712
4880

∴ 8.2% on investment
at $140 for M

2090) 5135 (2.4
4180
9550

208.9) 8550. (4.0
8356
1940

Receipts ~~1/2~~ of page ~~97~~
2 1/2 hours ~~3~~ hours

136.875
$68.437
57.303
$ 11.134 = 40% of five hours

~~208~~ 10% on investment

136.575
57.303
85.572

6.6% on investment

heating 1/2

at $225 to compare with gas

68.437
34.218
102.655
57.303
5 1.352

24% on investment

(2) Receipts

7200 lamps
.25 hours
36000
144
180 000 per hours per lamp
5
90,000 cu ft daily
365
90
32850
$1.50 per M M
1642500
32850
49,275.00

At $2.25 the present price of gas in N.Y.

49.275
24637
73912
51303
$ 22609 or 15% on capital,

See page 106 for five hours use same lamps

7200)300000 (41
288
120

16000
365
90000
108
54
3000)657000
219 hours per lamp

Costs 51653
Receipts 49.275
Loss $ 2378

With present plant (3)

6 per H. P. indicated

1200 Horse power

7200 lamps

3 per year

Coal $2.80 per ton at station

Building 1/2 again as much

Conductors $57.000

Five hours use a day

Investment

Structure	15 750
Boilers	30,180
Engines	24 000
Dynamos	35 000
Conductors	57 000
Extra Elec	2 000
Meters	5 000
	$168,930

7200
3
21600
.35
1080 00
648 00
7560.00

Depreciation

Structure	2% p105	$315
Boilers	10%	3018
Engines	3	720
Dynamos	3	1050
Conductors	2	1040
Extra Elec.	2	40
meters		250
		6633
Labor	p. 85	7,482
Coal	p 93	8,212
Oil &c		2,737
Rent & taxes		10,000
Executive		4,000
		39,064
Lamps		7560
		$46624

Receipts.

page 110 \$49.275
2
98550
46624
\$ 51,926.

168.9) 51,92 (30
5067
1250

\$1.50 per M

30% on investment

75) 10000 (134
75
250
225
250

1500 H. P.
10000 Lamps
6.6 per H. P.

134 Machines 75 lamps @ $350
134 Belts ~~Drives~~ @ ~~50~~
Average use five hours
Lamps costing 35 cts.

134
75
670
938
9900
10050

134
350
670.0
402
46,900

13400
6600

Investment (B)

Structure		15,750.00
Boilers	30000 7545 37725	37,725.00
Engines	24000 6000 30000	30,000.00
Belts		6700.00
Dynamos		46,900.00
~~Electrical~~ Testing Apparatus		3000.
Conductors		57000.
Meters		5000.
		202075.

46900
.03
1407.00

365
150
18250
365
5475 0
7482.
89 29 50

18212
2053
10265

Expense (B)

Depreciation

Structure 2% 210 / 105 / 315	315
Boilers and accessories 10%	3772
Engines 3%	900
Belts 10%	670
Dynamos 3%	1407
Testing apparatus 2%	60
Conductors 2%	1140
Meters 5%	250
	$8,514.
Labor	8029
Executive	4000
Coal	10265
Oil &c	3422
Rent Insurance &c	10000
Lamps	10500
	54,730

202,1) 150,6.0 (74
14147
9130

202075
101 037
303112

74
24
50

202.1) 82,15 (40.6
80 76
13900
11,4

41
14
27

202

Income

(B)

$2.25

205,312
54,730
$ 150,582

74% on investment of $202,075

Investment increased 50% for patent rights $303112

50% on investment

$1.50 Income $136,875
54,730
$82,145

41% on investment

27% on investment increased 50% $302,962

Power

1 Horse power at 8 pumps
per H. P. furnishes 40 feet
an hour or takes 25 hours
to make 1000 cu. feet

6 cts an hour per H. P.
at $1.50 per M this is 6 cts per
hour per H. P.

100 H. P. 10 hours daily

11205
100160
.342
3463

70 27

60
266
534

8212.50
2737.50
10950 00
2190
876.0

8212
1642
6570

10,500
2100
8400

65695
21905
87600
21900
109500

205,212
41.062
164,250

152,680) 122,510 | 80
122144
3660

152.7) 67.76 (43
6308
4680

164250
54750
109500

Estimate A modified to (4)
four hours a day

Same plant $152,680

Same depreciation &c, Same Expense except coal, oil, &c 1/5 less

35530,50
2190
33340 50
8400
41,740 50

Lamps 1/5 less

$2.25

Income 1/5 less

164,250
41,740
$ 122,510

80 % on capital
53 % on watered stock

109500
41,740
67,760

$1.50

43 %

29 % on watered

7)1200
7
8400

7)12000
1714
365
4
1460 h
8400
584000
1168
122640
30660
.35
153300
91980
1073100

1200
7
8400 lamps
8
8)(10000
1250
8750

Estimate A modified (D[a])
four hours a day
7 per H.P.
lamps last 400 hours

Same plant as (A) $ 152,680

Same coal Depreciation as (C) 33,340,5
lamps 10,731
44,071,5

Est-A, mod, To (T[β])
400 see page H / 157

8400 lamps
4 hours
2 feet

33600
5
168000
~~365~~
~~1008~~
~~1008~~
10920

365
168
2920
2190
365
61320
1.50
306600
61320
$ 91,980.00

lamps
8400 (1.50)
4
336.00

61,320
225
306600
122640
122640
~~306600.00~~
137970.00

(D)

Income

$ 1.50

91,980
44,071
47,909

152,680) 47,909.0 (.31 % on investment
45804
21060

20% on watered plant

$ 65,429.00

$ 152,680.00

1200 H.P.
3
3600 lb. hour
4
14400 day

365
14400
146000
146
365
2240) 5256000 (2340 tons year
4480
776
672
1040
896
1440

2340
3.5
11680
7008
$ 8176.00

Coal

2737
91.2
$ 1,825
8,176
10,001
8,760
1,241

2340
3.50
11700
7020
$ 8,190.00
Coal

8190.00
1825
10,015.00

Same as D 7 per H.P. 4 hours
Except coal $3.50 per ton
Conductors $75,000 400 hours life
Depreciation on conductors 3%

75000
57000
18000

152,680
18000
Investment $ 170,680.

Depreciation 3% on 75000
3
225000
1140
$ 11,10.00
1241.
33340.5
35691.5
10731
$ 46,422.5

More than D
" " D

6098
1110
7208

16569.50
164237
82118.7

~~Am~~ 365 days
4 hours

1460 hours
~~84,000~~

58,400

1168

12264 ~~000~~

61320

2.25

306600

12264

12264

1379 7000

11200
7
8400

(E)

Income same as (D)

91,880
46,422
45,458

1707)45.46(26.5 %
3414
11320
10442
8780

on $170,680

18% on watered stock

$85,340. for Patent Rights

365

Lamps 1/7 less

10731	
1522	1533
9209	9198

1200
6
7200

365
4
1460
7200 lamps
2.92800
.16220

400) 1051200
26280
35
131400
78840
91980

Present system 1200 H.P.
6 per H.P.
400 hours life
$75.000 in conductors
on which 3% depreciation

4 hours average use

$3.50 per ton for coal

Investment 202.075
18000
Conductors add $ 220075

Expense except lamps same as (E)
$ 35.691.5
Lamps 9209
$ 44900.5

$2.25 per M

78757
39378
118,135
44900
220) 73,235. (33.3 % on investment
66
72
66
63

22.2 % on watered stock

1/7 61,320
52,560,000 cu ft
2.25 per M
118,260.00
41,269.00 Expense
76,991.00 Net Income

(7)

Receipts 1/7 less than (B)

78840
39420
118260

191880
131490
788849
44900
33857

220) 33,8 (15.4 % on investment
220
1180
1100
800

$220.075

$110.000 for Patent Right

10.2 % on watered investment

202075/76,991/00
38%

200 H.P. in Power sold daily 10 hours

2000 H.P. one hour

Bark 1. Hand Powers 34 each may be counted as bringing 10 cts. per day Mr Kinney say

1 H.P. 6 cts. an hour
10 hours
60 cts

~~4~~ Count each as 1/4 H.P.

8 ~~1/2~~ H.P.
33
2.50
5
~~3~~
1~~4~~
7.5
9
7
9
5
70 8~~3~~ H.P. to rent

70
7 Horse

77 Horse power in Book
1 under 5 horse each.

Book 2
12 sewing machines
1/6 H. P
= 2 H.P.

.16
1 ~~.02~~
.75
50
50
25
6 00

11 .16 H. P

77
11.
1.2
~~7~~64

~~17~~64 H.P. in fann locks

Book 3

32 Hoists each 1/5 H.P.

6.4 H.P
1.5
1.
2

10.9 H.P
1.

11.9

Book 4

77 Hand powers
14 H.P.
60 Estimation Counted

~~7~~4 HP.

/152,680.00/852,238.25/

300 H.P. at least for
Ten hours
600 H.P for 5 hours
1200 H.P. for 2 1/2 hours
all the plant 2 1/2 hours

87,600,
1.50

438000
87600

\$ 91,980.00

Est-(I B)

Page 131

~~Since the life of 1 lamp is 400 hours which at 5 hours per day's use is Equivalent to 80 days duration.~~

~~And, Since 5 cu ft per hour is the Equivalent of 1 light or 25 cu ft per day~~

~~then the life of 1 lamp would be Equivalent to 2000 cu ft of gas and with 43,800 lamps would represent an Equivalent of 87,600,000, cu ft of gas~~

~~H.P.~~
~~1200~~
~~8 per HP~~
~~9600~~

~~400 / 17520000 / 43800 lamps used per year~~

~~365 d~~
~~5 h~~
~~1825~~
~~9600~~
~~1095000~~
~~16425~~
~~17520000~~

33000 4.5185
4312 3 6347

7.65 .18838
22 1.3424

2.2226

168 candles per H.P.

33000 4.5185
3535 3.5484

9.3 .9701
1.0792

2.0493

112 candles

Calculation for

House wire

16 candles 128.4
15 127.2

1.2 Volts

for a candle

1% of resistance in

conductors

150 Ohm lamp.

1.5 Ohms

50 feet 1.5 Ohms

$$\begin{array}{r} 24.8 \\ 12.4 \\ \hline 37.2 \end{array}$$

256 ; 340 :: 37.2 :

$$\begin{array}{r} 34.0. \\ \hline 8 \end{array}$$

$$\begin{array}{r} 1.5705 \\ 2.5315 \\ 7.5918 \\ \hline 1.6938 \end{array}$$

49.4 feet

Copper pure

Wire 1 ft. long 0.001 diameter having a cross section of one circular mill.

9.718 Ohms

97 : 100 9.718 Ohms 10.2 Ohms

$$R = \frac{l'' \times 10.2}{\text{Cross section}}$$

$$\text{Cross section} = \frac{l \times 10.2}{R}$$

$\frac{l}{2} = 25$ $R = 1.5$
$l = 50$

$$\text{Cross section} = \frac{\overset{10}{\cancel{50}} \times \overset{3 \times 4.}{\cancel{10.2}}}{\underset{.3}{\cancel{1.5}}} = 340$$

$l = 100$ $\frac{l}{2} = 50$

Cross section = ~~102~~ 680

$l = 150$ $\frac{l}{2} = 75$

Cross section = a = 1020

Wire 1 ft long 0''.001 in diameter

$12 \times 0''.001$

1000 feet of wire

0''.010 in diameter weighs

0·3026 lbs.

0''.001 in diameter weighs

.003026.

1 foot weighs

.000003026 lbs	$\bar{6}$ 4808
340	2 53.15
25 feet	1 3979
	$\bar{2}$.4102

.0257 lbs

2 wires

.0514

$l = 200 \quad \frac{l}{2} = 100$

$a = 1360$

$l = 250 \quad \frac{l}{2} = 125$

$a = 1700 \quad \frac{l}{2} = 150$

$l = 300$

$a = 2040$

$l = 350 \quad \frac{l}{2} = 175$

$a = 2380$

$l = 400 \quad \frac{l}{2} = 200$

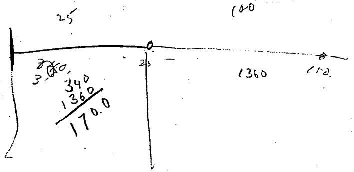
$a = 2720$

$l = 450 \quad \frac{l}{2} = 225$

$a = 3060$

$l = 500 \quad \frac{l}{2} = 250$

$a = 3400.$



~~Ohm~~

2 Ohm

3400 3 5315

3364 3, 5268

.0047

10.1

3364 3.5268

.3026 1.4808

1.0076

.0257 × 4 = .1028

.0257 × 9 = .2313

.0257 × 16: 1542, 257 = 4112

.0257 × 25: 1285, 514 = 6425

0257 × 36: 1542, 771 = 9252

0257 × 49

1.4102, 1.6902, .1004

0257 × 64

4102, 8062, 1.2164

0257

4102, 9542, 9542 = 3186

4102, 0414, 0414 = 4930

4102, 0792, 0792 = 5686

4102, 1139, 1139 = 6386

4102, 1461, 1461 = 7024

See page 165

line to factory

2 Ohms

$$
\begin{array}{r}
.0106 \overline{)\,1.0000} \\
\underline{530} \\
700 \\
\underline{636} \\
640 \\
\underline{636}
\end{array}
$$

(~~56~~ lbs to ohm

~~1132~~ ~~lbs to~~ 2 Ohms

1132 lbs .2 Ohms

~~ratio~~ ~~2~~ Ohm

0.5

~~2775~~

~~87 lamps~~

2
600
$6000

1500
150

181

181
16
1086
181
2896

120) 150 (1.25
120
300
240
600

2900

300
22
660

1.25
.125

~~1000~~

.125) 2000 (16
125
750
750

20
~~600~~

2000
.16
18000

4000
.22
8800

Line to Factory

2 ohms

1 Ohm No 10 wire
weighs 90.6 lbs

.0106) 1.0000 (90.6
954
600

181 lbs in 2 ohms

1200 lamps per day
2 hours on pumps
5 lamps per pump

240 lamps at 20 candles
6 per H.P
~~8 ...~~ H.P.
120 lamp at a time
20 H.P

340 mils 1 ft long

Sp. G. Cu = 8.9.

.000340	$\bar{4}$.5315
3.14	0.4969
Comp 4	9.3979
12	1.0792
8.9	0.9494
50	1.6990
	.1539
.03612	$\bar{2}$.5575
	$\bar{2}$.7114

.0514 O.K.

1000. feet No 10 wire
weighs 54. lbs.

~~225~~ 54

250

4 wires in & out
for 54 lbs.

$$\begin{array}{r} 30 \\ \hline \$\ 16.20 \end{array}$$

24 wires

$$\begin{array}{r} 16.20 \\ 6 \\ \hline \$\ 96.20 \end{array}$$

3 100 light

1450
4
5800

17956) 580000 (30 wires
54
58000
18

59 light
158 feet

4
7

2100
4
8400
68
504000

1790) 50400 30 10 wires

E 60 Lamps

1400
4
5600
80
18) 336 000 (20 No 10 wires

~~A~~ B 32 1000
4
4000
32
128.000

D

189 Ohms

.5½ mg

1½

12 feet

75

10

15 15
~~10~~ 15

50 feet high

10 lamps

99

500
100

17) 50000 (3 wires
6 wires
9 wires

152,680.00 / 852,288.75 / 5
763,488.00
8 68 38 2 5

Hamilton

8

1 Dining Room

3.5
8.
28.0
16
44 feet

~~4.5~~
2

Say 50

25

680
2
1360
25
6800
2720
34000

2 No. 10 wires
1 No 6 wire

See page 272 for calcu.

Total
~~160~~
200 feet No. 16 wire in entry

16,620 mills in 1A

3rd Story Line A

To ~~1A~~ 10 lamps

In hall 6, Rooms 2

Distance from Basement

$$\begin{array}{r} 20 \\ 15 \\ 15 \\ \hline 45 \text{ feet} \end{array}$$

To hall lamps

Average 56 feet

101 feet to hall

$$\begin{array}{r} \cancel{1300} \\ 1360 \\ 2 \\ \hline 2720 \\ 6 \\ \hline 16620 \end{array}$$

1 No 10 wire for 6 Hall lamps

200 feet No. 22 wire

2720 mills in A

$$\begin{array}{r} 16620 \\ 2720 \\ \hline 19,340 \end{array}$$

40 feet No. 10 wire down

Line A 3rd floor

4 lamps in rooms

25 feet average

separate line

$$\begin{array}{r} 340 \\ 2 \\ \hline 680 \\ 4 \\ \hline 2720 \end{array}$$

Line A 2nd Story

26 lamps

20 in hall

6 in Chamber

56 feet

$$\begin{array}{r} 30 \\ \hline 86 \end{array}$$ feet in hall

see page 213

Entry

~~150~~ 200 feet No. 6 wire

40,800

100 feet No. 17 wire

9000 mills through A

A line 2nd Story

75 feet

1020 mills
2 1/2 pounder
2040
20
40800

Nos 880 FRA

6 in Chambers

25 feet 3 line

average 25
30
55 feet

750
2
1500
6
9000

3000 mills

see page 215

~~150~~ 200 feet No. 6 wire

40,800 mills

100 feet No. 10 wire

23.200 mills
2
46 400

page 216

A line 1st floor

Nov 1880
JKL

60 Lamps

Hall 20 lights

56 feet out
20 from basement
76

1020
2
2040
20
40,800

Drawing room

40 lights 2 lines

30
25
55

680
2
1360
20
23200
2

A

30 feet No. 10

30 feet 4 No. 10 wires

40 feet 8 No 10 wires

In Basement

~~[illegible]~~

A line Nov 1880

2nd fl 3 JRU

16.620
2.720
19,340 mills
40 800
pt 6 2nd 9 000
69,190
40.800
46,400
17,958) 156,340 (8

100 feet No. 16 wire

8000 mills
30 feet No. 14 down

50 feet No. 18 wire
75 feet No 15 wire

6000 mills down
8000
14000 30 feet No. 11

B line

Nov 1880

3rd floor 4 lamps JKU

25
45
70

1000
2
2000
4
8000

Two circuits 4000

2nd floor 5 lamps

avrg 25
30
55

700
2
1400
2
2800
42
6000

175
~~100~~ feet No. 12 wire

27200
14000
41200 down

40 feet No ~~=~~ 6

B line
1st floor

LRU
Nov 18 80

20 lamps.

30 feet
20
50

680
2
1360
100
13600
13600
27200

C line
Same as B

TAE
Nov 14 1880

D same as B

50 feet No. 19

~~[illegible]~~ ~~19~~

3200 down

30 feet No. 17

~~75 feet No. 22~~

60 feet No. 19

30 feet
No. 14

4080
3200
7280

~~[illegible]~~

Nov 1880

~~[illegible]~~

E Line

3rd floor

2 lamps 20 45 65

800
2
1600

2nd

50 feet

680
2
1360
3
4080.

100 feet 2 No 10
Or 100 feet No 6

40 feet 68000
7280
18) 75280 (4

4 No 10 wires

Σ First floor
50 lights Nov 1880

3.5
8
28.0

20 feet to ceiling
28 feet
50 feet to go

680
2
1360 on side
25
6800
2720
34000
2 sides
68000 mills down

150 feet No. 16 wire

30 feet No. 12 wire
11424 mills.

~~Wf~~ 100 feet No. 13
19040 mills down

F 3rd floor
8 lamps Nov, 22, 1880

25 feet
45
70

952
2
1904
~~8 lamps~~
38066
3 circuits
11424

2end floor 32 lights
Parlor
1om 1 circuit

25 feet
50
75

952
2
1904
5
9520
2
19040

50 feet No 20

1360

~~75~~ 100 feet 2 No. 10
or No. 6

32646
1360
19040
11424
18) 64470

4 No 10 wires
30 feet

7 2 in bedroom Nov. 22 1880.
~~30 feet~~
25 feet

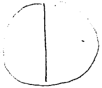
340
2
680
2
1360

20 in conservatory

~~30~~ 32
30
62

816
2
1632
20
32640

1000,000



~~Curr~~
100 lamps from top of
building ~~75~~ 30
20
110
160

2176
100
18) 217.600 (12 No. 10 wires
18
37.

back to street

Distributing
100 feet No 065

108,800 — $\bar{6}.4808$
40 — 5.0374
2 — 1,6021
.3010

26.3 lbs — 1.4213

60,928 — $\bar{6}.4808$
4.7860
1.8451
.3010

30. lbs — 1.4129

$\bar{6}.4808$
4.7267 — 53.312
1.8451
.3010

1.3536 — 22.5 lbs

Basement

A 100 lamps 40 feet

Nov. 22, 1880

544
2
1088
100
108,800

B 32 lamps 70 feet

952
2
1904
32
3808
5712
60,928 mills

C ~~28~~ lamps 70 feet

952
2
1904
28
15232
3808
53,312

	$\bar{6}.4808$
82824	4.9180
104	2.0170
	0.3010
52.1 lbs	1.7168

	$\bar{1}.4808$
165648	5.2261
104	2.0170
2	0.3010
	2.0189

104 lbs

D 104 feet 29 lamps

Nov 22 1880

1428
2
2856
29
25704
5712
82,824 mills

E 58 lamps
104 feet

2856
58
22848
14280
165,648

.00000 3026 $\bar{6}$.4808
217600 5.3385
158 2.1987
2.0180
3010
208 lbs 2.3190

~~Total Wt~~ $\bar{6}$.4808
474,368 5.4760
2.0414
3010
200 lbs 2.2992

F. 59 Lamps
158 feet Nov 2 2 1888

2176
2
4352
59
39168
21760
256,768

G 217,600 mils 100 lamps
110 feet

217.600
256.768
474,368

1,163 $\overline{).0657}$
.0328

1.08" diameter

Weight in basement

Nov 22 1880

26.3
30
22.5
52.1
104.
208
200.

6427 lbs. of Cu. in Basement

474,368
217 600
165 648
82 824
53 312
60 928
108 800

1,163,480

from page 178
Line A

$\bar{6}.4808$
4.2200
1.9542
0.6560

16,620.

4.5 lbs
4
18 0 lbs

16,620
8,215
4,107

Put 16.620
4
66480 mills to top A
200 feet
Then No:16 wire in entry

.054
.06

from page 182
Line A
Nov 22nd

$\bar{6}.4808$
4.6107 40.800
70 1.8451
.9366

8.64 lbs

4 | 40800
10.200

200 feet No. 12 wire

40.800
4
163200 mills

8.64
4
34.56 lbs

Vanderbilts house

40800

10200 200 feet No. 12

$\bar{6}.4808$
4.6107
1 60 = 1
.6936

4.94
4
19.76 lbs

40800
4
163200

 from page 184

Line A

11.600

$\bar{6}.4806$

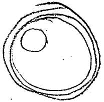
1.6665 46400

1.6021 40

.7794

5.61
2
11.22

46.400
2
92800



Line A summary

Vanderbilts house
Nov 2

Hall 3rd

200 feet ~~No. 16~~ = 0".065

Chamber 3rd

200 feet ~~No. 22~~ = 0".03

Hall 2nd

200 feet ~~No. 12~~ = 0".100

Chamber 2nd

100 feet 0".050

Hall 1st

200 feet 0".100

100 feet 0.100

To run to lamps in fixtures

100 lamps 6 feet each

600 × 2 = 1200 feet 0".030

Line A

I propose to put in one pipe 500000 mills of Cu.
In the other as much as possible

66.480
2720
163 200
163 200
92 800
488400

6.4808
5.6990
1.9542
2.1340 136 lbs.
~~.3010~~
~~1.4350~~ ~~272~~

12000
.3
36.00
$360

Vanderbilt's House
Nov. 22

Line B Total

Chamber 3rd floor

100 feet 0".065

Chamber 2nd floor

50 feet 0".065

100 feet 0".050

Parlor

175 feet 0".1 60 feet ~~.0~~".~~2~~ 2

40 feet 0". ~~15~~ 2

32 lamps 100

Lines C & D same as B

48000

Line E / Total

Vanderbilt's house

Nov 22

50 feet 0".05

60 feet 0".05

Dining ~~room~~

125 feet 0".2

30 feet 0".065

30 feet 0".1

4 no 10 wires 40 feet

75250 mills

F lines Vanderbilt house

Nov 22

150 feet 0".065

100 feet 0".1 — 200 0".1

50 feet 0".03 — 70 0".2

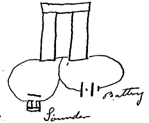
100 feet 0".2

G

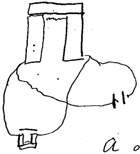
100 .065"

March 12, 1879.
Book 1 Page 121

The discharge from a magnet was measured



A click could be heard when the current was Taken off.



A double click could be heard

A duplex point was used to break the main circuit and the discharge thrown the sounder Results when no armature was on the magnet the discharge was

stronger, sharper and
of shorter duration than when
the armature was on

Book 1 Page 137
Tests of the power that could
be turned
Batchelor 10.963 ft. lbs
20 seconds

Francis 16.146 ft. lbs
10 seconds 15.225

Martin 14,100 ft. lbs
" 20 seconds

Geo. Carman
14,106 ft. lbs
20. seconds
Albert Swanson
17,191
15.750.

Kruesi 15750
14.445

Book 1 Page 245

If an armature has 10 lbs. of Cu on it and a resistance of 1 Ohm with 100 convolutions

If 10	Ohms	316	convo
5	"	223	"
4	"	200	"
2	"	141	"
1	"	100	"
1/2	"	71	"
1/3	"	59.7	"
1/4	"	50	"
1/9	"	33	"
1/16	"	25	"
1/25	"	20	"

Book 6 Page 40

The combustion of a cu. ft. of common gas will heat 65 gallons of H_2O 1° Fahr.

Haswell

1 Gall = 8.32 lbs.

$$
\begin{array}{r}
8.32 \\
65 \\
\hline
4160 \\
4992 \\
\hline
540.80 \\
5 \\
\hline
2704.00 \\
772 \\
\hline
\end{array}
\qquad
\begin{array}{r}
33000 \\
60 \\
\hline
1980000
\end{array}
$$

1,980,000)2,087,488(1.07

2,087,488 ft lbs

1 Gas burner burning 5 cu. ft an hour gives off a little more heat than is required to run a horse power for an hour.

Estimate for rewinding - Dec 6 1880

The small cast iron motor which gave 32.6 Volts at 1640 revolutions per minute from six turns in a division

It can be run with safety 2500 r. p. m.

1640 : 2500 :: 32.6 :
2500
163000
652
1640) 81500 (49
6560
1590

49 volts

Say 50

The most that will ever be needed for any lamps will be 150 Volts and this can be ~~obtained~~ at

2500 r. p. m

3 X 6 turns in each section

18 turns

.045
.01
56

Dec 24

Armature 37 Coils

@ 5" diameter

3.14
5

74) 15.70 (.21
148
90

0".21 for space

3.7
2
74

118
60

5
3

To be wound with .021 wire

4 X 20/6 = 40/3 = 13.3
.68
133
798
9.113

9.1 Ohms

Magnet 6" iron

wire 049
.011
.060
6
.36

30
70
2100

40 minute
60
240

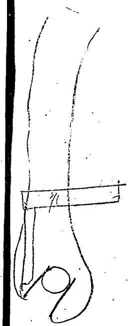
46
70
3020 feet

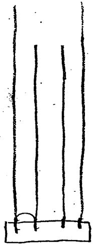
14.6) 70 (5

5 lbs. of wire

Dec 6 1880 FRU

Arrangement for testing Lamps at Factory





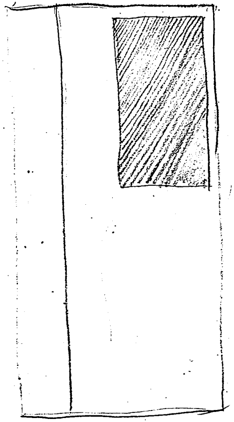
$$C = \frac{E}{R+r}$$

$E =$ Constant

$$C = \frac{E}{R+r}$$

$$R+r = \frac{E}{C}$$

$C = 1$ Weber



The machine can only run the lamp to be tested. For if it has its field to run, the current to the field will interfere with that to the lamp.

Let C_ℓ = current to lamp
C_m = " " magnet

~~Ea~~ ~~Eg~~ Drop in machine

$= E_a = (C_\ell + C_m) R_a$

$C_\ell R_\ell = E_\ell = E - E_a$

$C_m R_m = E_m = E - E_a$

$C_\ell R_\ell = C_m R_m$

The magnets from the
machines must be fed
from main line to factory;
For a standard light
Candles standard are
the best but very expensive.
a ~~Carcel~~ oil lamp would
also be very good
I think a kerosene oil lamp
using rather a light oil
~~with [illegible]~~
siphon the same as a
student lamp so as to
keep a constant height of
oil. A student lamp would
do.

This could be standardized
to candles at intervals.
so as to give eight candles
or any given number
- - - - - -

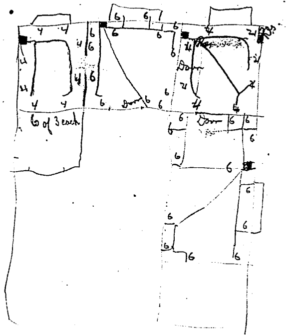
There will be a double
switch so as to put the
machine either on a
resistance or on the
lamp which is to be tested
The machine will be run
at 2000 r.p.m. and the
connection made through the
Electro Dynamometer ~~so as to give~~
~~one certain deflection~~ and
the deflection read. Then
magnet is adjusted until

The deflection is brought to a standard amount which will have been calculated to follow from having ~~[illegible] volts~~ 140 Volts on the line

1st floor

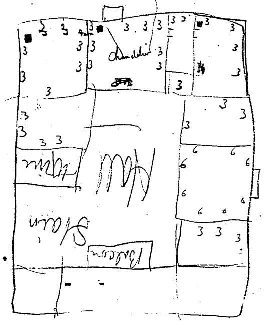
5th Ave

13
78

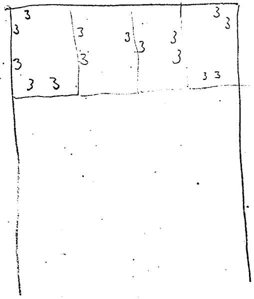


2nd floor

for room underneath
50 lights



3rd Floor



6889 mills in No 14 wire

A Line omitting all lights to the hall

Third floor 9 lights

3 lights 16 feet

$$\begin{array}{r} 204 \\ 3 \\ \hline 612 \end{array}$$ mills X 3 = 1836

3 light 16 feet

612 mills X 3 = 1836

3 lights 8 feet

Down 153 mills X = 459

9 lights 35 feet through pipes

$$\begin{array}{r} 476 \\ 9 \\ \hline 4284 \\ 3 \\ \hline 12852 \end{array}$$

2 No 14 wires

1 No 12 wire

A line second story

18 lights 20 feet

$$\begin{array}{r} 272 \\ 20 \\ \hline 5440 \\ 3 \\ \hline 16320 \end{array}$$

1 No 10 wire for second story

A line 1st story

12 light 50 feet

$$\begin{array}{r} 680 \\ 12 \\ \hline 1360 \\ 680 \\ \hline 8160 \end{array}$$

O K

9 lights 35 feet ~~112~~

$$\begin{array}{r} 476 \\ 9 \\ \hline 4284 \end{array}$$

12 lights 11424

$$\begin{array}{r} 4284 \\ 11424 \\ \hline 15708 \end{array}$$

Down

No. 10 wire

B line 3rd Floor

Floor 24 feet 6 lights

$$\begin{array}{r} 340 \\ 6 \\ \hline 2140 \\ 3 \\ \hline 6420 \end{array}$$

No 14 wire

Down ~~12.76~~ 12 feet 6 lights

~~35 feet~~

12 lights

3/2 the Cu

$$\begin{array}{r} 476 \\ 12 \\ \hline 952 \\ 476 \\ \hline 5712 \\ 2856 \\ \hline 8568 \\ 2856 \\ \hline 11424 \end{array}$$

~~No. 12 wire~~

B line 2end floor

12 lights

Down

20 feet

$$\begin{array}{r} 272 \\ \underline{12} \\ 544 \\ \underline{272} \\ 3264 \end{array}$$

No. 14 wire

B line 1st floor

O. K

carry wires to Basement

C line 3rd same as B

Down No. 12 wire

2end Floor
21 lights 20 feet

$$\begin{array}{r} 272 \\ 20 \\ \hline 5440 \\ 3 \\ \hline 16320 \end{array}$$

No 16 wire

1st O.K

D line

Third floor

10 lights

35 feet

Down

No. 11

4765
3
13295

12 lights Second story

20 feet

272
12
544
272
3264
3
9792

No. 12 wire

pat O.K.

E Line

15 lights 3rd Floor

35 feet

$$\begin{array}{r} 476 \\ 15 \\ \hline 2380 \\ 476 \\ \hline 7140 \\ 3 \\ \hline 21420 \end{array}$$

Down

No. 10 wire

40 lights 2nd Floor

20 feet

$$\begin{array}{r} 272 \\ 40 \\ \hline 10880 \\ 3 \\ \hline 32640 \end{array}$$

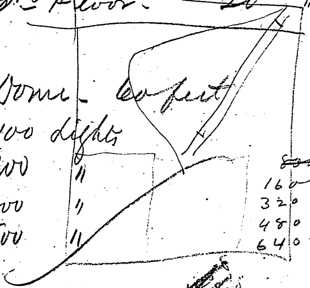
2 No. 10 wires

1st O.K

1st Floor ~~—~~ 50 lights
2nd Floor — 20 "
3rd Floor — 20 "

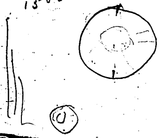
Dome — Cupola

100 lights
200 "
300 "
500 "



800
~~80000~~
160000
320000
480000
640000

30050
15000



3 No 5 for each
100 lights

Summary

Line A

From 3rd down 1 No. 12 wire
clear through 9 lights

From 2nd down 1 No. 10 ~~wire~~
18 lights ~~3 wires~~
4 wires

Line B

From 3rd down 1 No. 10 —
clear to basement 17 lights

From 2nd down 1 No. 14 —
12 lights

Line C

From 3rd down 1 No 10 —
17 lights

— 2nd — 1 No. 10 —
21 lights

Line D

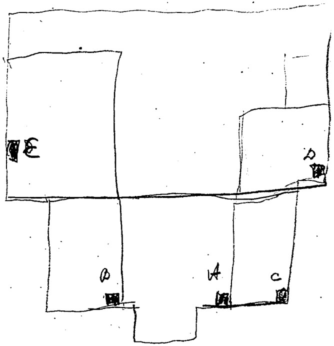
From 3rd down No. 12 —
10 lights

" 2nd " 1 No. 12 —
12 lights

Line E

From 3rd down 1 No. 10 —
15 lights

From 2nd " 2 No 10 —
40 lights


E
D
B
A
C

$$\begin{array}{r} 120. \\ 3 \\ \hline 360 \\ 60 \\ \hline 4\,2\,0. \\ 5 \\ \hline 2100. \end{array}$$

75 c
17
92 —

11) ~~500~~ 398. (36
33
68
66
2

1.50.

10c / ton per ton
7 c Ammonia Ligr —

12) 22000 (1833.
12
100
96
40
36
40.

4800. Engine
1833 - Wire.
2500 Piping Paying
2100 Boilers —
550 Feedwater pump
300 Piping —
800 flooring structure,
400 Blower-Bunker
250 Station apparatus,
250 Stock & setting

13783.

7

3 5000.

120
12
240
120
1440
1520

21
12
42
21
252.00

~~[illegible]~~

120
8
960. Lights

4 lbs per hp - 120
4
480 - hours
5
2400.

) 5000.

Meters 100 — 500

Investment 13783.
960. Lights —

ton coal per 5 hours
~~5 [illegible] tons~~
~~at 3~~ — ~~#8~~ per 5 hours
Engineer 3
Oil water 0.50
18 50
2.80
8 Lamps
Dep 1.50.
Rent 1.50.
Taxes Ins. 25
2455
1200
1255

Dep. 4 p.c. on ~~[illegible]~~
520 per year — or 1.5 ¢ per night

13
40
520.

d
365
5 h
1825 kil.
9600
17,520,000
43,800

H P
1208
9600

61320 cu ft gas
1,50 per M
3066000
61320
91,980,00

91980
46802
45,178

Apr 15, 1886

170,680.

45,178 00 | 26
341360
1104200
1024080

76
20
1520

76 / 1255 (14
76
365
304
61

76

76
16
456
76
1216

960
16
5760
960
15,360
5
76,800

76
50
3800

Menlo Park Notebook #174 [N-80-11-09]

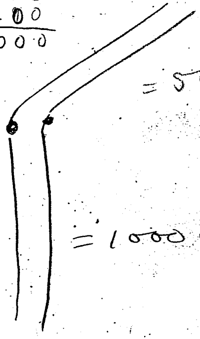
This notebook covers the period October-November 1880. Most of the entries are by Francis Jehl. There are also a few entries by Francis Upton. The book contains notes and calculations relating to lamp tests. A few of the entries concern tests of meters. The label on the front cover is marked "Lamps C" and "Francis Jehl." There is an index on the inside front cover. The book contains 282 numbered pages.

Blank pages not filmed: 234-235, 264-265.

Index.

Res one arm of Bridge
70.3 ohms

$$\begin{array}{r} 12600 \\ 1400 \\ \hline 14000 \end{array}$$



= 500

= 1000 ohms

2 First Lamp. good vacuum.
Em7 182 - 183 $\quad$ Pt 3683

R $\dfrac{31400+4500}{200} = 179$ R

C 16 $\quad$ first test

at oct 27 another test

R 193
Pt 3529

25150
5800
200 | 3095 (154

3 No 1^c. 3/8 Spark

Em7 167 - 167 $\quad$ 1110

R $\dfrac{25150+5800}{200}$ 154 R

C 16 $\quad$ Pt Clamp $\quad$ 3544 P

167
167
3 | 334
111

154) 545820 (3544
462
838
770
687
616
660

154

The following on inside of front cover.

$$R^0 = \frac{4}{5} \quad \frac{4}{5} = 1^0 C$$

$$\frac{4}{5}$$

$$\cancel{20}\,^{C}$$

$$x C^0 = \frac{4}{5} R$$

$$20 R = x C^0$$

$$20 : x : \frac{4}{5} : 5$$

Elut	218 218 1450
R	$\frac{37650 + 6800}{200}$ 222R
	4195 Alb
C	16 Fe

37650
6800
20)44450 (222R
40
45

218
2
3)436
145

3^e

Em. 7	190 — 190 126 v
R	$\frac{37650}{200}$ 188 R
©	16 7^e ~~3070~~ 3730

$$\begin{array}{r} 190_2 \\ 3\overline{)380} \\ 126 \end{array}$$

200) 37650 (188
200
176
160
165

188) 703310 (3740
...
1386
...
752
...7

4 e

Ellit	189 – 189	126 ✓
R	$\frac{37650 + 300}{200}$	189 R
C	16	3721

Je

189
2
3)378
126

37650
300
20)37950(189
20
179
160
195

69)70310(3721
[illegible]
1363
[illegible]
401
378
230

Ent	188 188		1220
R	$\frac{37650 + 300}{200}$		189 R
Q	16	Fe	3488 Hb

$$\frac{188 \times 2}{376} \div 3 = 122$$

$$\frac{37950}{200}: \; 20)\,3795 \;(189$$

$$\begin{array}{r} 3795 \\ 20 \\ \hline 179 \\ 160 \\ \hline 195 \\ 180 \end{array}$$

$$189)\,659320\;(3488$$

$$\begin{array}{r} 567 \\ \hline 923 \\ 756 \\ \hline 1672 \\ 1512 \\ \hline 1600 \end{array}$$

7

12

6^c

13

Em 7 192 − 192 = 128 c
R 37650 + 4200 ÷ 200 209 R
@ 16 3473 ft
Fe

192
2
3)384
128

37650
4200
20)41850(209
40
1

209)725810(3473
627
989
836
1531
1463
680

EMT 192-192 1280
204 R

R $\frac{\cancel{37650 + 3200}}{200}$

Re 3552 /lb

C 16

$$\frac{192 \times 2}{3} = \frac{384}{3} = 128$$

$$\begin{array}{r} 37650 \\ 3200 \\ \hline 20)\overline{40850} \\ \hline 204 \end{array}$$

204)725810 (3552
612
1138
1020
1180
1020
6.00

Emt 191 — 191 127v

R $\frac{37650 + 3700}{200}$ 206 R

e 16 Ve 3468 lb

191
3|382
127 20)41350 (206
40
135

206)71450 (3468
618
965
824
1412
1236
1760

9e

Elw7	184 − 184 123 P
R	$\frac{37600 + 2000}{200}$ 198 R
C	16 3384 lbs

184
2
3368
123

37650
2000
20)39650(198
20
196
180
165
160

198)670210(3384
594
762
594
1681
1584
970

198
8
1584
7

Elut 203 - 203 1350

R $\frac{31400 + 500}{2000}$ 159 R

O 16 $\frac{}{}$ 5077 lbs

This one has a splint,

$$\begin{array}{r} 203 \\ 3\overline{)406} \\ 135 \end{array} \qquad \begin{array}{r} 31400 \\ 500 \\ \hline 2\overline{)31900} \\ 159 \end{array}$$

$$159\overline{)807370}(5077$$
$$\begin{array}{r} 795 \\ \hline 1237 \\ 1113 \\ \hline 1240 \end{array}$$

159 × 7 = 1113

159 × 8 = 1272

11e Nu

Eut 190 – 190 1230

188R

R $\frac{37650}{200}$

C 16 20) 3765 (188

126

16

3564 // 66

190

2

3) 380

123

188) 67020 (356.4

1062

940

1224

930

12 Ni

EMF 193 − 193 129 V

R $\frac{37650 + 1500}{200}$ 195 R

C 16 3780 Abb

A [illegible] in the Carbon

$\frac{193}{2}$ 2 37650 1500

3)386 20)39150 (195

128 191 180 115

195)737700 (3780

585 1527 1365 1570 1560 00

Eut 173 – 173 1150

R $\frac{31400 + 500}{200} = 159R$

C 16 36-1 Atto

Agin the globe

$$\begin{array}{r} 173 \\ 3)\overline{346} \\ 115 \end{array} \qquad \begin{array}{r} 31400 \\ 500 \\ \hline 2)\overline{31900} \\ 159 \end{array}$$

159) 5570 (38
477
1087
954
1347
250

Enut 173 − 173 = 115 v
155 R

R $\frac{31400 + 4700}{200}$ 3779 #lbs

C 16

31400
4700
2)36100
155

173
2
3)346
115

155) 58578 (377.9
465
1208
1085
1231
1085
1520
1395

Poorly Clamped

Elu# 207 2½ 1380

R $\frac{37650 + 4500}{200}$ 210 R

407

C 16

$$3\overline{)414}\quad 207$$
138

37650
4500
20)42150 (210
40
26
15

210) 84365.0 (4017
84
365
1550

16^e Ni

Cut 198 – 198 = 1320

R $\frac{37650 + 6500}{200}$ 220 R

3509.4 c5

@ 16

198 – 198
2 | 396
132

37650
6500
20 | 44150 (22
40
41
40

220) 772020 (3509
660
1120

...

Em7 195 − 195 = 130 v

R $\frac{37650}{200}$ = 188 R

392.8

© 16

$$195 \times 2 = 390$$
$$390 \div 3 = 130$$

20)37650 (188
20
176
160
165
160

188)73870 392.8
564
1846
1792
547
546
1710

223) 18362.0 (35.14
1115
 ...
870

18 C hi

Euit 200 - 200 1330

R $\frac{37650 + 7000}{200} = 223$

3514 lbs

C 16

Blue at the Lamps and Hg in the Globe

3)400
133

37650
7000
20)44650(223
40
46
40
65
60

19e ni

Em7 190 − 190 = 127 ✓

R $\frac{37650 + 700}{200}$ 191 R

3740 fills

R 16

$\frac{190}{2}$ 3|380 127

37650 + 700 = 38350; 20)38350 (191 = 20, 183 = 180, 3

191)714520 (3740; 573 = 1415; 1337 = 782; 764 = 18

20° hi

Shift 187 − 187 = 1240

183 R

R $\frac{31400 + 5300}{200}$

C 16

$$\begin{array}{r} 187 \\ 2 \\ \hline 3)374 \\ 124 \end{array}$$

$$\begin{array}{r} 31400 \\ 5300 \\ \hline 2)36700 \\ 183 \end{array}$$

183) 6 7 1 1 6 0 (3722

5 4 9 7 x

1 3 2 1

1 2 8 1

4 0 6

3 6 6

4 0 0

Emf 195-195 1300

R $\frac{37650 + 700}{200}$

© 16

195
2
390
130

37650
700
20) 38350 (191
20
183
180
35
20
15

191) 748670 (3919
573
1756
1719
370
191
1790

Emt 185185 1235

177R

R $\frac{31400+4000}{200}$

3786 [illegible]

C 16

$$\begin{array}{r} 185 \\ 2 \\ \hline 3)370 \\ \hline 123 \end{array} \qquad \begin{array}{r} 31400 \\ 4000 \\ \hline 2)35400 \\ \hline 177 \end{array}$$

177) 670310 (3786

531

1392

1239

1531

1416

1150

1062

88

177

1239

23e. nì

Cuit 194 − 194 1290

199 R

R $\frac{37650 + 2200}{200}$

3704 fl lb

© 16

$$\begin{array}{r} 194 \\ 3\overline{)388} \\ 129 \end{array}$$

$$\begin{array}{l} 37650 \\ 2200 \\ 20)\overline{39850}(199 \\ 20 \\ \overline{195} \\ 180 \\ \overline{185} \\ 180 \end{array}$$

$$\begin{array}{l} 199)\overline{737200}(3704 \\ 597 \\ \overline{1402} \\ 1393 \\ \overline{900} \\ 995 \\ 4 \end{array}$$

Em7 178–178 117 V
184 R

R 31400 + 5500
200 3294 fills

C 16. 31400
178 13700
3 | 356 2 | 36900
117 184

184) 606420 (3294
552
544
368
1762
1656
8606
736

Clif 180 — 180   120 V
188 R

R $\frac{37650 + 100}{200}$ 3393

C 16

$$\begin{array}{r} 180 \\ 3\overline{)360} \\ 120 \end{array}$$

20)37750

188)637920 3393
564
739
564
1752
1692
600
564

Eu+ Very high resistance
R
Q

27e ni

Emf 195 – 195 130 v
1200 R

R $\frac{37650 + 2500}{200}$

3243 [illegible]

e 16

$$\frac{37650}{42150}\ 200$$

$$\frac{195}{2}$$

$$3\,|\,\underline{390}$$
130

200) 7486.70 (3243

486

67

Em7	198—198 138 U 213 R
R	$\frac{37650 + 5000}{2000}$ 3624 lbs
C	16

Bad spot at Clamp

$$\frac{198}{9)396}\quad 132$$

$$37650 + 5000 = 42650 \qquad 20)42650(213$$

$$213)772020(3624$$

970

Ent 183 − 183 122 V
189 R

R $\frac{37650 + 200}{200}$ 3488

C 16

183
366
122

37650
200
37850
176
188

189)659360(3488
567
923
756
1676
1512
1640

Eut 185 — 185 1235
171 R

R $\frac{31400 + 2800}{200}$

3919 ft

C 16 185
2)370
123

31400
2800
34200
171

171
2
39

171) 60219 (3919
1602
1539
331
171
1600
1539

Ent 178 — 178   119 U
178 R

R 31400 + 3200

200   3632 ft lbs

C 16

178
2
356
119

31400
3200
2)34600
173

173)62733
519
1083
1038
0553
519
440
446

3632

Elut# 184 – 185 1385 173R

R $\frac{31400 + 33000}{2.000}$

3874 lbs

C 16

Hg in the globe

184
185
369
123

31400
33000
31040
15520

173) 670270 (3874
519
1512
1384
1281
1211
700
692

173 × 8 = 1384

173 × 7 = 1211

Cut 195 – 193 1290
228 R

R $\frac{37650 + 8000}{200}$

C 16 3233 ft lbs

195
193
3388
129

37650
8000
20)45650 (2

228 | 737200 (3233
684
532
456
760
684
760

Em 7 179 ÷ 179

$$\frac{37650+}{200}$$

R 3337 ft lbs

C 16

179
2
3|358
119

188)62730 (3337
564
633
564
693
564
1290

188
7
1216

Emt 189—190 126 V
20 × R

R $\dfrac{37650 + 4000}{200}$ 3381 fils

@ 16

189
37650
379
126
208) 703310 (3381
6244
793
624
1691
1664
270

EW# 185 — 185 1235

R $\frac{37650 + 1000}{200}$ 3472 ft lb

C 16

$$\begin{array}{r} 185 \\ 2 \\ \hline 370 \end{array} \quad \begin{array}{r} 37650 \\ 1000 \\ \hline 38650 \end{array}$$

370) 38650 (193

193) 670200 (3472

500

EM7 184 184 123 5
1840

2 $\frac{31400 + 5500}{200}$:

C 16 3642 fl lb

31400
5500
2)3690.0.0
184

184
2
3)368
123

184)67021.0 (3642
552
1182
1104
781
736
450

38 ℋ

Emf · 190 − 190 1295 194 R

R $\frac{31400 + 8500}{200}$

3590 fills

C 16

199
2|380
127

314
31400
8500
2|39900

199
199) 7145220 (3590
597
1175
995
1802
1791
1.0

123
14 R

Ent 185 — 185

31400 + 8500

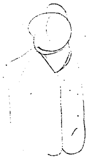
R 200 3367 fills

C 16

185
2
3370

31400
8500
39900

123
199) 67210 (3367
597
732
597
1351
1194
1570



Emit 173 — 175 116 5
158 R

R $\frac{31400 + 200}{200}$ 3772 ft lbs

© 16

173
175

3)348
116

31400
200

2)31600
158

158)596100 (3772
474
1221
1106
1150
1106
440

Jele JEH
JEH

E Nit 179 − 179 119 v
174 R

R 31400 + 3400

2 00 3606 fll

31400
34000

16 2)34800
174

179
2
3)358
119

174)627339(3606
522
1055
1044
1130
08

C.M.A. 190 − 190 1270 1700

R 31400 + 4300

200 4014 ft.lbs

C 16

190
3)380
127

31400
4300
3)35700
178

178)7145 20 (4014

2 5 2
1 7 8
7 4 0
7 6 8

EM7 200 - 200 1330

215

R

$$\frac{37650 + 4500}{200}$$ 3731 fill

C

16

37650
4500

3 / 1400 / 133 20) 4215 4210

210) 783620 (3731
630
1536
1470
662
620
320

Elu7 200 − 200

R $\dfrac{37650 + 4900}{200}$ 3696 ft lbs

16

3)400
133

$$
\begin{array}{r}
212\,)\,783620\ (3696 \\
636 \\
\hline
1476 \\
1272 \\
\hline
2042 \\
1908 \\
\hline
1340
\end{array}
$$

45c ~~Nit~~ 7e

Ruf $180 - 180$ 1200
184 R

R $\dfrac{31400 + 5500}{200}$ 3466 ft lb

C

16 31400
5500
$2)36900$
184

180
$3)360$

$184)637920$ 3466
552
859
736
1232
1104 2
1280

Em4 175 - 175 1175

R 31400 + 8000
200 3766

C 16

175
31350
116

31400
8800
2 | 32200
161

161) 606420 (3766
4834
1234
1127
1072
966
1060

47c

Cut 200 - 200

1335
212 R

Q $\frac{37650 + 4800}{200}$

3696 ft lb

C 1.6

3)400
133

37650
4800
20)42450 (22
24
20
45

96
60
24

Eint 180 - 184 1210

R $\frac{31400 + 3500}{200}$ 3727/lb

C 16

180
184
3864
121

174) 64560.00 (3727
522
1266
1218
480
348
1320

EMF 202 - 202 134V

$\frac{37650 + 7000}{200}$ 3567 ftlb

Q

C 16

Carbon has a bad

start.

223) 795450 (3567
669
1264
1115
1495
1338
1570
1561

Emt

R

C

181 — 181 1915

31400 + 2700

2000 4412 lb

16

147) 648600 (4

441

07

147(648600 (4.412

588

606

588

180

147

330

294

	Volts	Ohms	Ft lbs
1	111	154	35[illegible]
2	145	222	4195
3	126	158	3730
4	126	189	3721
5	122	189	34[illegible]
6	128	209	3473
7	128	204	3552
8	127	206	[illegible]
9	123	198	3384
	135	159	5077
11	123	188	3564
12	129	195	3780
13	115	159	3681
14	115	155	3779
	138	210	4017
	132	220	3509
17	130	188	3928

Volts

38	127
39	123
40	116
41	119
42	127
43	133
44	133
45	120
46	117
47	133
48	121
49	134
50	121

18	133	223	3514
19	127	191	3740
20	124	183	3722
21	130	191	3919
22	123	177	3786
23	129	199	3704
24	117	184	3294
25	120	188	3393
26	120	200	3343
29	122	189	3488
30	123	171	3919
31	119	176	3632
32	123	173	[illegible]
33	129	228	3233
34	119	188	3337
35	126	208	3381
36	123	193	3473
37	123	184	3642

20 cell

$\frac{101.5}{20 \times 1.18} \times 419$

2.0064
9.9666
86990
.6710

4.9

9.3290
2.6222
1.9512
1.9512
1.6464
7.6830
3.2318

Test of lamp No 37

Batteries 50.5 L
51 R
101.5

1 Candle

209 L 89.4 Volts
210 R
419

37650
3900
41550
207.75 Ohms

1706. Ft.lbs.

9.3290
2.6547
1.9837 96.3
1.9837
1.6964
7.6920
3.3058 202.2

2 candles

225 L
227 R 225 / 226.5 / 451.5 96.3 volts
225 L
226
37650 20.22 ft. lbs
3000
(40650
203.25 Ohms

9.3290
2.6875
2.0165
2.0165
1.6464
.7010
3804

3 candles

242 L
245 R
487

3 1/3 candles
103.7 Volts

37650
2250
39900
199

199 ohms

Batteries 51.5 R
50 L
101.6

240 ft lbs

~~2.6994 6~~
~~2.6~~

9.3290

9.3290
2.6946
2.023.6
2.0236
1.6464
7.7051
3.3987

Batteries lamp adjusted

49.5 L
52 R
240 R from 3 candle

10 1.5

105.5 Volts

4 candles

~~245 L~~ good
248 R
247 L
495

37650
1600
39430
197.25 Thus

2505 ft lbs

9.3290
2.7110

2.6400
2.6400
1.6464
7.7062

3.4326

5 candles

257
256 L 1095

258 R
514

37650
1700 2707.5

39350
196.75 Thurs

9.3290
2.7259
2.0549
2.0549
1.6464
7.7122
3.4684

1131.3

7 candles

265 L
257 R
532

113.3 Volts

37650
1150
3)8800
194. Ohms

2940 ft lbs

9.3290
2.7443

2.0733
2.0733
1.6464
7.717B

3.5103

9 candles

275 L
275 R
272 L
276 R for 37650
Sons.

8½ candles?
9 candles
279 R
276
555

118.5

276
279

37650
700

38350
191.7

3239 fl.lbs

6

17
.8
.025
2
.050

.3
.300

.017
.008
.025
.050
.3

7 100 : 83 :: .300
83
249
684
7089
.300
21 26.7

800
12
9600

.212
800
169.600
64.8

9.2 makes [illegible]

.3290
.7559
.0849
.0849
6464
7207
5369

11 candles

285
285 R
285 L
570
37650
400
38050

121.5 [illegible]

3440 [illegible]

3290
7716

10 06
10 06
64 64
72 58

5734

14 candles

294 L
297 R
591

.1261 Volts

31400
6200
3.76 00
188

3743 ft. lbs

3290
7810
1100
1100
6464
7276
5940

16 1/4 candles

296 — 297 15¾ ÷ 17

16 candles

300 L

302 — 306

300
304
604

31400
6050
37450
187.25

128 Volts
3926 Ft. lbs

3290
7860
1150
1150
6464
7312
6076

18.5 candles

306 R
305 L
6 11

130.5

31,400
5750
37150
18575

4051

3290
7983
1273
1273
6464
7364
6374

4340 ft. lbs.

2½ cuttles

315 L
316 R
310 L
31400
5300
36700
183.5

316
312.5
628.5

1341 volts

4340 ft. lbs.

27 candles

323 L

332 R 30 candles

31400

5000 27 candles

To 4800

33 candles

325 L

31 candles

325 L

330 R

325-326 L

3290
6998
0288
6258
6464
7089
4129

5 candles

249 L
252 R
501

106.8 Volts

31400
7700
391.00
195.5

2588 ft.lbs

3290
7404
.0694
.0694
6464
7212
5064

9 candles

272 L

277-276

275 L

273.5
272.5
5500

31400
6600
38000
190

3209

3290
7582
0872
6872
6464
7258
5466

12 1/4 candles

284 L
284 L
289 R

284
289
573

122.4 Volts

31400
6200
(37600
188

3520

3290
61.60

9450
9450
6464
6840

22.04

1 candle

.205 L
2
413

31400
10000
41.400

207.00

Batt.
48.5 L
51.5
1810

.88.2 volts

1661

Corrected curve

Candles		Ohms	Volts		
1		207.5	89.4		
	4.25	203.25	96.3	6.9	
2				6.7	
	3.65	199.6	103		
3				3	
4	2.1	197.6	106	2.9	
5	1.5	196.1	108.9	2.7	
6	1.3	194.8	111.6	2.4	
7	1.1	193.7	114	2.2	
8	1	192.7	116.2	2.0	
9	1	191.7	118.2	1.7	
	.7	1910	119.9		
10	1.4 .7			1.55	3.1
		189.6	123	1.5	
12	.7	188.2	126	1.2	
14	.6	187	126.4	.8	
16	.55	185.9	130.3	.8	
18	.6	184.7	132.1	.8	
20	.45		1338		
22		183.8			

89.4 9513
9513
6464
6830
2320 1701

1

9836
9836
6464
6920
3056 2021

2

6128
6128
6464
6998
3718 2356

3

106 0253
0253
6464
7048
197.6 ~~3925~~
4011 ~~2409~~ 2518

4

108.9 0370
0370
6464
7075
196.1 4279 2678

5

111.6 0469
0469
6464
194.8 7104
4506 2823

6

114 0569
0569
6464
193.7 7129
4731 2972

7

116.2 0653
0653
6464
192.7 7152
4921 3105 8

118.2 0726 9
191.7 0726
6464
7175
5091 3230

119.9 0751 10
191 0751
6464
7190
5156 ~~3270~~

0788
0788 3334
6464
7190
5230

123 0899 12
0899
6464
189.6 7221
5483 3535

126 1004 14
1004
6464
188.2 7253
5725 3738

128.4 1086 16
1086
6464
7282
187 5918 3907

130.3	1149	18
	1149	
185.9	6464	
	7307	
	6069	4045
		20
132.1	1209	
	1209	
184.7	6464	
	7336	
	6218	4186
		22
133.8	1265	
	1265	
	6464	
183.8	7357	
	6347	4312

51 e

210 - 210 140 Volts

$$\frac{37650 + 1400}{200}$$ 195

16

37650
1400
20) 39050 (195
20
180

250
2
3) 500
166

227 — 227

227
227
454
151 Volts

$\frac{07650 + 1400}{200}$ 195

16

Blue at the Clays

37650
1400

20) 39050 (195
38
190
180
10

✓

Note with Lamp (Coated
nickel No 3

120 Volts

180 – 1.80

$$\frac{25150 + 5300}{200} \quad 152$$

16

$$\begin{array}{r} 25150 \\ 5300 \\ \hline \end{array}$$

2+5

20)30450(152
20
104

54 ©

215 — 215

$\frac{430}{143}$ Volts

37650 +

208

630

37650
4000
20) 41650 (208
40
1

note with [illegible]
[illegible] [illegible] [illegible]

190 − 190

$$\begin{array}{r} 190 \\ \underline{140} \\ \underline{340} \\ 123 \end{array}$$

$$\frac{31400+}{200} \quad 157$$

16

576

$\frac{(470}{153}$ Volt

$$\frac{37650+7500}{200} \; 225$$

16

37650
7500

20) 45150 (225
40
51
40
115

57e

207 – 207

(494
134 Volts

37650+
200

188

Blue at the clamp

200) 37650 (188
200
1765
1600
165

✓

58

note ([illegible])

198 — 198

$$\frac{1396}{132}$$ [illegible]

$$\frac{31400 + 20000}{200}$$ 167

16

Blueat [illegible]

$$\begin{array}{r} 31400 \\ 20000 \\ \hline 2 \,)\, 33400 \\ 167 \end{array}$$

5 9e

198 — 198

$\frac{396}{132}$ Volts

$\frac{31400 + 7000}{2000}$ 192

16

$$\begin{array}{r} 31400 \\ 7000 \\ \hline 2\,)\,38400 \\ \hline 192 \end{array}$$

60 c

Note (No Ammeter)

(410 / 133 Volts

205 205

$$\frac{31400 + 3000}{2000} \quad 172$$

31400
3000
2)34400
172

Note (No 3 Nickle)

217 – 218

$$\frac{37650 + 2000}{2000} \quad 198$$

217
218
435
145 Volts

16

Blue at the clamp.

37650
2000
20)39650(198
2
196
180
160
160

134 : 154 :: 195

2900
1875
8729
3504

+ 22. + ohms

62c

202 - 200

(404
134 Volts

$$\frac{37650 + 1500}{200}$$ 195

16

37650
1500
2)39150
195

20)39150(195
[illegible]
190
115

63 e

205 - 205

$\frac{410}{136}$ Volts

$\frac{31400 + 35000}{2000}$ 174

16

31400
35000

2 | 34900
174

205
2

3 | 410
136

136 : 154 :: 174

2405
1875
8665

2945

197
174

+23 Ohms

222 - 222

37650 + 7000 146

200

223

$$\begin{array}{r} 222 \\ 3\overline{)444} \\ 146 \end{array}$$

16

2

37650
7000

20 4 4 6 5 0 2 2 3

46

65

200 - 200 133

$$\frac{37650+2500}{200}\ 200$$

16

$$\frac{3,400}{133}$$

37650
2500

201401 50 (200

133 : 154 :: 200 :

3010
1873
6761
3646 +

231 1/2
200
31 1/2

190 — 190 126

$$\frac{31400 + 57000}{2000}$$ 121

16

$$\begin{array}{r} 314000 \\ 57000 \\ \hline 3)364 \\ 121 \end{array}$$

67 ©

215 − 215 = 143

$\frac{37650 + 7000}{200}$ 223

16 $\frac{215}{2}$

3) 430

143

37650

7000

200) 44650 (223

40

46

6ye

190 — 190 126

$\frac{31400 + 5300}{200}$ 123

16

$$\begin{array}{r} 31400 \\ 5300 \\ \hline 3\overline{)36900} \\ 123 \end{array}$$

69e

190 − 190   126 U

$\frac{31400+}{200}$ 157 R

16

$$\begin{array}{r|l} & 192 \\ 3 & 380 \\ \hline & 126 \end{array} \qquad \begin{array}{r|l} 2 & 314 \\ \hline & 157 \end{array}$$

Tested the Elect
of the light [illegible]
for Mr Bachner.
Cent 140

70 C

184, 184

$\frac{25150 + 5700}{200}$

16

25150
5700
30850
154.25

184
368
123

123 ; 154 :: 154.25 :

2.1875
2.1875
79104
2851

192.7
150
38

+ 38 ohms

mekke no 2

213 - 215

$$\frac{31400 + 6700}{200}$$

16

72e

Nickel no 1

204 – 200

31400 + 5500

200

31400
5500
36900 18450

202
200
462
134 Volts

1.34 :: 154 :: 184.5

18904
3659
8799
3342

215
184.5
30.5 Ohms

Stop here to test Dr
McKees meter.
leading wires .33 ohm
with meter 2.85

2.85
33
2.52 ohms.
This was when
I was in Reims.

~~78c~~

~~a Special experiment~~

228 - 228

228
228
456
152

37650 + 1500
2 ——)

16

37650
1500
39150
195.75

152 : 154 : : 195.75 :

2916
1875
8182
2973

198
195.75
2.25

+

2 1/4 Ohms

75 C

Nickel No 2

195 − 195

$$\begin{array}{r} 195 \\ 195 \\ \hline 390 \\ \hline 195 \end{array}$$

$$\frac{31400 + 3700}{200}$$

16

19

$$\begin{array}{r} 31400 \\ 3700 \\ \hline 35100 \\ \hline 17555 \end{array}$$

190 : 154 : : 175.5 :

$$\begin{array}{r} 2[illegible] \\ 1[illegible] \\ 8861 \\ \hline 3166 \end{array}$$

$$\begin{array}{r} 201 \\ 1755 \\ \hline 255 \end{array}$$

+ .255 Ohms

(Nickle no 2)

$$\frac{37650 + 40000}{2000}$$

16

$$\begin{array}{r} 37650 \\ 40000 \\ \hline 20\overline{)\,47650}\;(208 \\ 40 \end{array}$$

77e

Nickel A o 2

140

210 - 210

$\frac{37650 + 4500}{200}$

16

37650
4500
42150
21075

140 : 154 :: 210¾ :

3237
1875
8539
3651

232
210¾
+ 21¼ Ohms

$$\begin{array}{r} 238\frac{2}{2}\ 2c \\ 3\overline{)476} \\ 158 \end{array}$$

Nov. 9

Camp put them at this day at 8.30 in the night.

74c lasted 10.9 oclock

56c
65c Nov. 12
8c
~~24~~c

10.10.32 Nov 9 1

Meter Check at

9. 53.

(10.3'.32") 10.

10 27 21
10 15 7
1214

10 3 32
10 15 7
25

10: 3 32
9

8

10 1.5 67
10 3 32
11: 35

9

10 5 3
9.5 3

~~10 5 3~~
10 63 32
9.5 3
10.32

six

10.15 67
10 3 32
11.35 Live (?) ...

10.15' 7"
10.27 21
12.14 Right

50
32
311

10 39 21
10.27 21
12.0 Left

10 39 21
12 14
27 35

10 51 20
10 39 21
11.59 Right

68
50
21
59

51 20
12
63:20

11.15 26
11 5 9

26 85
27 60
25

62
20
42

63
51
12

11 27 25
12

39 : 29

62
51
11

3 22
11 59

14 81
60
15 : 21

71
15
20
59

10 15 7
10 . 27 21
12 . 14 } Right

10 39 21
10 27 21
12' } left

10 51 20
10 39 21
11 : 59 } Right

11 3 22
10 51 20
12' . ~~4~~2'' } left

11 15 . 26
11 3 22
12 4 } Right

11 27 25
11 15 26
11 . 59 } Left

11 39 33
11 59

50 92
50 32

50
39

11

20
62

52
33

49

11 39 33
11 27 25

12 8

Right

51 22
11 39 33

11 49

Left

2.17609
2.17609
1.64640
7.62343

3.62201

4170 ft lb

78 e

37687 × 80.800
225 —— 225

37687
10000

2) 47687

238 ohms

16

228
225

450

150 Volts

126
126
756
252
126
15876
44.3
47628
63504
63504
703306
182) 703306 (3.860
5466
1573
1456
1170

3868) 33000 (85
3088
2120
30

~~4~~ 79¢

190 + 190
31406 + 5000
200
16

1.90
1.90
3.80
1.26 Volts

31406
5000
36406
1.82 Ohms

190 – 190

3 1406 + 4300

16. 178

81 @

197 – 197

$$\frac{37687 + 4500}{200}$$

16

82 e

203 - 205

37687 + 2700

16 = 28 [illegible]

1192 — 192

37687 + 7500

16 175 61:110

84[e]

210 – 210

37687 + 5000

16 223 [illegible]

85 ©

191 191
37684

16 188 ohms

202 — 202
37687+ [illegible]

16 203 [illegible]

87©

192 – 192

31406 + 4800

16 179 Shis

195 – 195

37687 + 3000

16 203 Ohms

185 - 185

31406+3700

16 175-

90e

195 – 196

37687 + 2000

16 198 [illegible]

207 - 207

37640
2406
28 | 40 120
208

36840
2840
28 | 39680
298.

46407
6032
4041
5862
28 | 52342
261

34680
3604
28 | 38284.
291

35687
4680
28 | 40367
201

5608
3807
5680
28 | 14095
70

15 kly. 1 D—
13 2 ond
120 tried to get 150
current broke on one
0. kly
110 kly.
122 kly
126 kly.
123 kly.
122 kly.
0 kly
~~160~~
160 brought to 750 kly.
168
170
160.
164
0 kly
150 kly
0 "
105 "

~~1280~~ 139
2
3 | 278
322
2 92 2/3
162
2
3 | 324
108 / 360 | 644
4 214
1440 120
2 2
3 | 240
2880 .406 420 80
6 8421 139
17280 2
3 | 378
3 129
57 8.40 148
2 2
183 680 3 | 296
40833 98 2/3
4062
3041
.147
2
3 | 294 2 = 11 196
98 5598
142 130
2 2
3 | 284 3 | 260
94 2/3 86 2/3
86

Second Test

~~2 ohms~~ 2 ohms

142 Def. 2 ohms
139 Def. "
142 1.0 "
130
0 Def.

3780
4760
3268
4832

4760
3210

17976 20) 17540

39

87

10680
3226

222.4

7608
3642

20) 50726

25272

4680
3242
4274

47880
2100

20) 50328

25272

6045
3604

403

91 © nickel not

204,204,

37687 + 2500

16

92 c nickle no $\cancel{t}$

200 198

37687 + [illegible]

16

215 – 215

37657 + 1000000

16

~~180 – 180~~ 182 – 182

31406 + 4000

16

2000 - 2000
37687+1500

16

96c

202-202

37687 + 4 ton

16

97C

200 - 2000

37687-6000

16

98°

Burned [illegible] with
very [illegible] [illegible]

180 - 180

31406 + 2000

16

106

175 - 175

31406 + 4[illegible]

16

187 – 187

37680 + 1700

16 :

1.00e

175 −175

31406

16

109C

194-194

37 687 + 3000

106

195 - 198

37687 + 1700

16

217 – 217

37687 + 9000

16

183^c

220 - .279

37687+1000

16

to high R

$$\frac{(BC+CE)(AB+EA)}{BC+CE+AB+EA} = \frac{BC.AB.CE+BC.AB.EA+CE.EA.BC+CE.EA.AB}{BC.CE+AB.CE+BC.EA+AB.EA}$$

$AB.BC+AB.CE+BC.EA+CE.EA =$

$BC = a$, $CE = b$, $AB = c$, $EA = d$,

$$\frac{(a+b)(c+d)}{a+b+c+d} = \frac{ac}{a+c} + \frac{bd}{b+d}.$$

$$\frac{(a+b)(c+d)}{a+b+c+d} = \frac{ac(b+d)+bd(a+c)}{(a+c)(b+d)}$$

$$(a+b)(c+d)(a+c)(b+d) = ac(b+d)^2 + bd(a+c)(b+d) + ac(a+c)(b+d) + bd(a+c)^2$$

$$2abcd = a^2c^2 + b^2d^2.$$

two high R

$a+b$
$c+d$
$ac+bc+ad+bd$
$a+c$
$a^2c+abc+a^2d+abd+ac^2+bc^2+adc+bdc$
$b+d$

abe abe

ceea

$be^2 = = bee$

$$X = \frac{(Be + Ce)(aB + Ea)}{Be + Ce + ab + Ea}$$

$BC.AB(CE+EA)+CE.EA(BC+AB)$

$$\frac{AB \cdot BC + AB.CE + EA.BC + EA.CE}{BC + CE + AB + EA} =$$

$$\frac{AB(BC+CE) + EA(BC+CE)}{(BC+CE)+(AB+EA)} = \frac{BC.AB}{BC+AB} + \frac{CE.EA}{CE+EA}$$

$(B\ +CE)(AB+EA)$

205

205 205

37600 + 1000

16

$$\begin{array}{r} Be + Ce \\ ab + Ea \\ \hline ab^{e}c + abee \\ Beea + ee^{2}a \\ \hline ab^{2}c + 2abee + ee^{2}a \\ \hline \end{array}$$

$Be + Ce + ab + ea$

$$\begin{array}{r} 32 \\ 5 \\ \hline 160 \end{array}$$

$\frac{5}{9}$ 7 $\frac{57}{9} - \frac{160}{9} = 45$ 4

$$\begin{array}{r} 45 \\ 4 \\ \hline 405 \\ 160 \\ \hline 5)565 \\ 113 \end{array}$$

$$\frac{ce}{ca}$$

$$\frac{ab}{bc} \quad c^2ca$$

$$\frac{ab^2c}{bc+ab} \quad c^2ca \quad \frac{ce}{ca} \quad cc^2a$$

$$\frac{ab^2c}{bc+ab} + \cancel{c^2a}\ \frac{ce^2a}{ce+ca}$$

$$\frac{abc}{c+a} \quad \frac{cea}{c+a}$$

C
O
N
H
Cl
Fl
Br
S
P
Si
B
Sel
G

70 ✓
76 no ∂
72 ✓
74 ✓
75 ✓
77 ✓
72 ✓
65 ✓
63

675

Menlo Park Notebook #176 [N-80-00-07]

This is the third of three notebooks that contain the results of a search, conducted by Otto Moses during the summer of 1880, for literature relating to the electric light. (See also Menlo Park Notebooks #127 and #128.) The citations are listed in alphabetical order by author. There are two sets of listings, beginning on pages 2 and 88. The book contains 284 numbered pages.

Blank pages not filmed: 98-284.

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Woodward, C., 2.

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Borel, —

Böttger, Rudolph., 83

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Production of a galvanic copper deposit on cotton cloth
Schweizer. Gesell. Verhandl. 1846 .. 40-41

Loop carrying On the movements which present themselves in a galvanic circuit at the places where the conductors touch each other very lightly.
Lausanne, Compt. Rend. Soc. Suisse, XLV., 1861 .. 34-40

On the electricity developed in mercury by filtration.
Majocchi, An.

Globes. On the exhalation of bicarbonate of ammonia by the lungs.
Phil. Mag. XXX., 1847 .. 124-125

Menlo Park Notebook #177 [N-79-03-00]

This undated notebook was used by Francis Upton to record references to generators found in Menlo Park Notebooks #1-#13 and #15. It probably dates from 1880 or 1881. The label on the front cover is marked "Note Books" and "Index Machines." The book contains 282 numbered pages.

Blank pages not filmed: 42-282.

Book 1 page 25
Tuning fork machine good drawing Dec. 15, 1878

Page 27 plan connections magnets

P. 29 same

31 ~~Drawing~~ tuning fork machine

33 length vibration tuning fork

35 Train of gears to run dynamo dated Dec. 17. 1878 sizes given and machine partly drawn

37 fork machine

Book 1

Various forms Dec. 26, 1878.

45 – 52

Faradic testing machines

to discuss laws page 53

p. 54

90 – 97 various diagrams

of currents from magnets

pages ~~104~~ 102 107 figures on

gears.

p. 111 diagram

113 Wheatstones bridge of

magnetism

March 12

Book 1, page 121 – 125

The discharge from a magnet measured by means of sounder. Armature on the magnet tried and then removed and the discharge was found to be stronger sharper and shorter.

page 131 Figure of armature

Book 1 Page 137–153

Tests of man power

Book 1 p. 219 – 223

Figures as to dimension magnets

Also p 232 laws concerning economy

Page 245 Table of resistance armatures

10 Ohms	316 turns
5 "	223 "
4 "	200 "
2 "	141 "
1 "	100.
&c	&c

page 246 "picture" long magnet.

248–249. figures relating to resistance

Dated Search these 3 March '79

Book 1 page 254 — ~~257~~

Plans of connections for testing wire when hot
No date
Book 2 page 9-11 Switch for Wallace machines Dec 10, 1878.

Book 2 p 13 Tuning fork Dynamo Dec. 10
Book 2 p 15 Tuning fork dynamo plan of steam cylinder and magnets. Dec. 10
p. 16 direction Dec. 11
p. 19 Gramme machine commutator current plan.
Dec. 20
page 21 When the internal resistance of magnet equals external best effect. Edison

Book 2 page 23—25.
Gramme machine diagram
p. 27 Gramme with rotating
magnets
p. 28 Ring and magnets ro-
tating
to Page 72 various dia-
grams of magnets and
line of force undated
On page 75 date of exs in
bringing up spirals by battery
Feb. 8, 1879
Gramme machine used on
spirals page 85 resistance
in line with spiral which
measured cold .73 ohm
and had in line with it
D.K. about 4 ohms

Book 2 pp. 90-91

Ends armature Edison's first magneto

Book 2 p. 149

Date Mac Laughlin return from the Chaudiere river June 6, 1879,

Picture of machine im-mediatly following this

Two binding posts at the base

Book 3 from p 73-81 undated diagrams of magnets

Date near this March '79

Book 3 p- 143-150 ~~comm~~

Date Jan 12-15, 1880

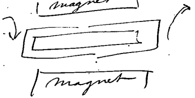
Commutator drawing by Mr. K

to page 177 a number of undated drawings of magnets and machines

Book 4 p. 33 No date
drawing resistance coil
Book 4 p ~~39~~ 41-45 no date
counter shaft for running Gramme
at various speeds
Immediately after date.
Jan 22 1879

Book 4 Page 77 — 105
Feb. 15, 1879.
Edison's magneto electric machine Account of exp to get
current speaks of putting
a battery and the Gramme
machine on the magnets
and obtaining an arc.
refers to
Book 7 pp. 169-175
9 " 181
28 " 1-81

Diagram machines
On page 123 is the wonder where disks are revolved in the opposite directions so as to take in all the lines of force —



To page 145 various diagrams undated of machines and magnets. after these Page 147 Feb. 19, 1879 account of Exps on magnets. Where the current of the Gramme was put on the Edison and the Edison on the Gramme to see if the machine turned harder.

Book 4
Page 155 Date Feb. 19, 1879

Battery put on Gramme and the ring run. Three iron wires heated four feet long

Gramme on Edison

Page 159 Feb. 20 1879

Suggestion as to opening one side of Gramme to run Jablochkoff.

Page ~~182~~ 185 No date

Directions for making boxes for resistance

Immediately after date March 10, 1879.

Book 4 page 280, 282 no date

Diagram connection

Book 5 Nothing

Book 6 p12 ~~Extracts~~ No date
Estimates concerning the power required to drive the Wallace machine

Book 6 p 21-39 No Date
Various estimates as to Gramme efficiency and diagrams of magnets and coils

Book 6, Page 47-51 No date
Estimate capacity Gramme
Notes of various experiments
No dates. ~~followed by date of Jan 30, 1879~~ where the Gramme was used to bring up wires. followed by date of Jan 30 1879

Book 6 no dates to.
a large number of calculations
as to distribution, cost, and
diagrams of no great importance.

Book 7, page 9. Dec. 13, 1878.
attempt at non commutator

Book 7 page 23 Dec 17 1878
T.A.E.

De Meriten form of dynamo
machine showing a powerful
~~to~~ magnet.

page 25-27 Dec. 17. 1878
various forms of

page 31 Dec. 17, 1878 ~~T.A.E.~~
Small Gramme for Telephones

page 33-60 Dec 17, 1878
Various forms of dynamos
and especially the early
drawings of Edison's first

Book 7, page 61

Dynamo machine Dec. 29, 1878
Full drawing of ~~E~~ Edison's first machine.
Sketches follow this by Batch
pages 62 – 138 under dates Jan 1 to Jan 7 are various sketches of the loops of the Gramme and the Siemen's machines showing how they are related and and a number of attempts to commutate the currents from a series

Page 139 Jan. 7 1879
Drawing for resistance box.

Page ~~147~~ 149 Jan. 7, 1879;

Book 7
The iron lamp
is shown on page 151
Date Jan, 9. 1879. F. A. E.

From page 169–213 Jan 9–Feb. 15
a large number of devises
for commutating currents
and the ~~devises for~~ di-
agrams of connections for
the Edison dynamos.

Book 8 Faradic machines
Page 13 Dec. 20. No. 1.
Test machine for driving ~~Machines~~

Pages 80 to 138 a large num-
ber of tests of the Gramme
machine showing the relation
between the strength of current
and the E. M. F from the
armature.

Book 8.
Page 138-175 May 10, 1879
Tests of the Edison machine

Page 176 Speaks of the magnets being quantitized and the coils connected by threes this was for the Jeannette

Date soon after of June 9, 1879

Under date of June 10, 1879 is mention New machine Gramme on magnets and after that follows some tests showing relation between current on field and E. M. F from armature

June 11, New machine on its own field

Rest of book Test from June 11

to June 13 showing relation of field to the E.M.F. of the armature

Book ~~[illegible]~~ 9 Dec 15'78
pages 5-13 T.A.E.
Dynamo Mac

Book 9. page 25-29 Dec. 16 1879.
Dynamo machines

Book 9. p. 49-75 no date
machines
page 77 Wheatstone bridge for magnets
page 77 — 109 no date
magnets devices
Then date Jan. 14, 1879
145-155 ~~no~~ date
magnets devices

Book 9 page 175
Feb. 16, 1879

Gramme ring electric en

page 187-211 Diagram
of connections Feb. 15, 1879
for commutating

Book 10 from pp 96-end
full of drawings for testing
the theory of magnetism
and also sketches for
Edisons first magneto.
Dec. 16, '78 to Jan. 1, '79

Book 11

p. 13 Non commutator no date
15 Lines of force " "
19 Non commutator Dec. 28, 1878.
21–29 – – —— no date
31 Faraday's magnet. no date
37 Magneto machine no date
details

82–~~83~~ Split ring Gramme
Feb. 20, 1879.

83 Winding Siemens Feb. 20, 1879.
84–85 Non commutator Feb. 20, 1879.
86 Remark "Move the commutators and make the Gramme give off any current that may be required from it." Feb. 20, 1879.

87–89. Non commutator
95–100 Edison's Dynamo Feb. 17, 1879
101–110 Non commutator Feb., 1879.
110–127 —— ——

Rest of book no date and only attempts at non commutator at interval

p. 3 attempt Non Comm —— No date
5-9 Exs. on friction using a magnet to take off the weight. Dec 20, 1878.
11 Gramme machine balanced with battery. no date
13-69 Non Commutators No dates.
J 86-87 I final brought to mea Jan 10 1879

No dates
Estimates of lamps
attempt ~~noan~~ commutator

Book 13

Book 15

p. 47-5 Large ring machine March 9, 1879

89 Mr. Edison speaks of experiments with small dynamo March 5, 1879.

Menlo Park Notebook #179 [N-80-00-02]

This undated notebook was used by Francis Upton to record notes and calculations about the lamps needed for the steamship City of Rome. It probably dates from 1880. The book contains 284 numbered pages. Only one page has been used.

City of Rome (Steamship)

~~Hon Statesmen lights~~
~~on lower deck~~

16 candles
59 lights 16 candle power
on lower
30 " on upper dec
16 " promenade
105 of 16 candles
25 Engine room
130
8 candles
74 on upper of eight
64 in saloon
137 lower deck
275 lights of 8 candles
20 in passage ways
295 8 candles
130
425 lights in all
50 HP Engine

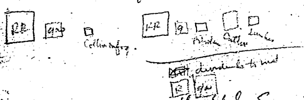
Menlo Park Notebook #184 [N-80-06-16.1]

This is one of six notebooks that were probably begun on January 10, 1881. It is a draft of a proposed book by Edison to promote his system of electric light and power distribution as a replacement for gas lighting. (See also Menlo Park Notebooks #187-#191.) The label on the front cover is marked "Prospectus Book." The spine is stamped "Edison's Prospectus Book." The book contains 284 numbered pages.

Blank pages not filmed: 18-19, 32-39, 58-145, 148-163, 166-175, 178-187, 190-197, 200-201, 204-213, 216-219, 222-225, 228-235, 238-249, 252-267, 270-273, 276-281.

Electricity vs Gas
~~Gas~~ general illuminants

The gas interest of the world
Early history adverse opinion
scientific men, its gradual rise
to be one largest industry in the
world, to illustrate its magnitude as
compared other industries



Money invested in the US. Eng
the Continent, & bal world - favorite
investment -

Defects as Domestic Illuminant - but superiority over other Combustion methods
Danger = great cost piping house - leakage
Suffocation (get statistics) defects burners
rapid deterioration. Optics of Eye effect
~~vacillating~~ inconstant Illumination

Object E to Effect exact imitation
of all done by gas ~~[illegible]~~ so as to replace
lighting by gas by ~~[illegible]~~ lighting

by Electricity

to improve the illumination to such an Extent as to meet all the requirements of Natural Artificial & Commercial Conditions

A general system of distribution only possible way to meet requirements economical illumination Electric distribution analogous to distribution of gas and water —

The accomplishment & perfection of a general system its readiness for introduction only awaiting business men of Energy & Capital

as isolated illumination in Mills etc outside the limits of gas distribution of cities, & special illumination for advertising & other purposes in cities & of which a small per cent of the total illumination, and as of not general interest for the public we shall leave the consideration of the rest this book

The Creation of a new industry opening a wide field for profitable investment of Capital.

Its only effect on gas investment being to gradually cause the present gas interest to cease the manufacture of illuminating gas & go into the manufacture & distribution of heating gas

The advantages of heating gas - its cheapness, the market ~~that~~ could & would be created the effect being to not only not effect the enormous invested

interest of gas to actually increase its ~~the value~~ capacity of Earning.-

Table showing amount sold in M^s yearly in principal cities world - What its sold for the money invested per M sold. Costs in holder Cost distributed,

List gas Cos in U.S. small type Capital &c-.

Difficulty getting any reliable statistics.

Give statistics of every kind as obtained in our district

In connection with these statistics mention premium use Kerosene; Give its cost as against gas,

(

Capability of replacing gas illumination by electric illumination in every particular & general description of the System

give Estimates to the Cost of plant - Operating Expenses in large cities = ditto smaller cities - also where Water power alone - also where Water power part time with Steam plant Case necessity -

Depreciation of Electric plant VS gas plant =

In this Connection obtain gas depreciation from their own experts + ours from Users of Boilers Engines

Give all tests at Menlo park

Map—

Indicator tests—dif Engineers

Coal tests

Photometric tests—different competent pers

Life of Lamp tests, ~~dif~~

Dynamo Efficiency test = Clark - Upton - Young & Brack[?]
also Young & Brackett with Porter [illegible]

Estimates Examined & reported upon by several good Engineers

Another Review of the whole thing as worked upon upon pure science principle by Rowland - Young Trowbridge

also Rowland on the
possibilities & probabilities of
cheaper production by better
manufacture higher incandescence
without decrease life of lamps

~~[illegible]~~

~~Repts~~

Cheap meters small Expense
wires allowing poor to use it
1 jet will pay - as one jet
of 16 candles can be subdivided
without loss of economy into
2 of 8 or 4 of 4 candles
this Especially desirable
for the poor

The transmission of power
The RR at Menlo park the Shops
the tests :- The general
distribution of power & light.
How that it doesn't matter if
Elec is used for light or
power : its peculiar advantages
its subdivision into small
power with economy - The
small industries of N York
present way getting small
power Cost & inconvenience
Extra Rents.

Availability of Electric Motors - measuring aggregated work on meter = useable night or day - ~~Impossibility ... that gas engine~~ ~~Impossibility~~ uncommon of small steam motors = First cost gas motors, their Complication -
Domestic Motors Manufacturers
Cuts + description of these
The profits derived from the Sale of power independent of light - give table

lessened cost of light
when power sold
give table when various
amounts of light + power
sold

Storage unnecessary - instance
water works - Ocean Steam
probabilities with 12 Engines
+ boilers 0.000 —

statistics of power in our district –

generally poorest dists for light best for power; thus evening up whole city – the effect of this on investment.

Effect of distribution sale small powers will be to create immense amount of small industries

Previous inventors failed -

necessities for commercial

success & accomplishment by E,

E great effort not to make a large light

or a blinding light, but a small one

having the mildness of gas

Speak of arc lighting ~~at present~~

~~used mostly~~ ~~...~~ ~~...~~ the

entirely distinct field large

areas, ~~...~~ ~~...~~

~~...~~ ~~...~~ ~~...~~

~~light, ...~~

E. L. Co. Hold the system by

broad patents - give dates

application patents - patents

allowed & claims -

unassailable by any prior

publication & Claims so

far allowed — Opinions as to validity in Court of the patents = opinions well known men — (negative Evidence — Preece, Morton others)

Speak of numerous & large works contemplated for manufacturing lamps — The Capability to increase output, it being new industry, necessarily quality of lamps improve ~~[illegible]~~ a diminished price, both tending to allow of the sale of illumination more cheaply to public

Notes.

Curve field magnet 3 sizes on same plate = also iron & copper investment & labor — also Energy line — 10 pc maintain!

Curve Energy (28) ft lbs: Candle power & EMF of A B C & other lamps obtained candle by candle experimentally — Upton Curve now made with 6 cd. lamp — also the Curve with different incandescence

---

Ditto Motors —

Laws Motor transfer power on general distribution system — also in isolated case

Graphic representation consumption gas Jany to Dec — also a Curve Shewing ~~average~~ daily Consumption each month of year — one Card Shewing 1 day in June 1 in Jany —

Table fall EMF
Formula —

Laws relating to ft lbs — unit incandescence =

Curve life lamps at different Emf — also different incandescence

Curve Rise ~~Resistance~~ Conductivity in Cu
Ditation meter =

all other table for meter

Table weight Copper required different
distance 100 ohm lamp 16
Candles

Increased consumption as you go
outwardly from station - Show
map then make Copper table
Showing increased investment
in Copper as you extend area
illumination

Shew graphically by circles
illumination by 1 light of 10 gas
jets + 10 of 1 gas jet. the gain

Loss by subdivision gas (17).
Smaller amount gas dont give
proportionate illumination

Represent loss fts lbs in Dynamos
+ lamps from 1 to 1 to 30 to 1.
giving graphic Curve show
gain ~~large~~ Energy its Cost
extra investment to obtain
the economy. 10 p.c. interest.

Represent relative Costs different Illuminants by block or ~~[illegible]~~ lines one dollar will buy

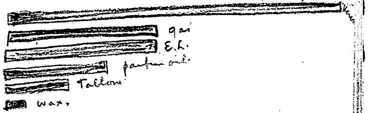


Table Costs Motors

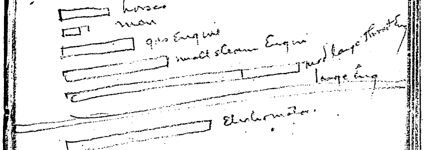


Table ~~both~~ Curves shewing increased economy by larger Engine higher powers starting 1/4 hp Eng.

Ditto E Motor.

Table relative gas invest[illegible] [illegible]

~~[illegible]~~

~~[illegible]~~

in figures

Table cost lighting stove 50 Kerosene Lamps - labor-wicks Chimneys - Candle power ditto in Comparison gas also investment required

Depreciation.

Comparative
Size of conductors in gas & E
Supply same areas in city

E.L. ○ (gas) - Relative Cost.

○ ○gas
E.L.

Yearly depreciation

○ (gas)

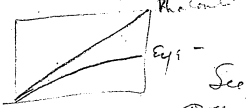
Value if disused & sold in market.

(E.L.) ○gas

Relative size in house
E.L. ○gas - Cost.

Curve actual drop Cand be given obtained by experiment .14 machines, 25 lamps ~~on then~~ 1 on. also gradually from 25 down — same of ~~radius~~ / machine Res reduced 1/2 Keeping EMF same, —

Photometers & probable Curve of decreased sensibility of Eye to increasing illumination



See, work on Optics Helmholtz etc

in speaking of Ill by E.
Coal Trade Journal of June 16 1880.
says that the application of gas to Heating Cooking etc would still return handsome dividends to the shareholders Even if ~~a source of~~ illumination by it was wholly superseded by Electricity

---

So unpleasant is the effects of the products of the Combustion of gas that the new Madison Square theatre Every gas jet is ventilated by special tubes to carry away the products of Combustion

Opposition to Bessemer -
"Steel by Grains - page 54 -

Candle power Paris gas 12 candles.
Vide Haywoods report on Holborn.
Viaduct: Annual G. L. April ~~[illegible]~~ 1879.

ann gnl gasl - May 16/79

McCormicks report.

Gas act (English) of 1875 limits sulphur compounds to 30 grains per 100 C F ammonia 5 grains actual results last few months of Lecture, sulphur 28, ammonia 0.47. Copland Lecture in B Jul of Lighting April 29 1879

Cost working gas Engine, attendance
Cost plant etc - ammgas Lgne
Sept 16 1880

April 29 1899 Jnl of Gasl British
Lecture by C. Copland, M Inst CE
Late Supt & Engr British Gaslight Co at Hull,
stated. Total invested in world little
over £300,000,000.

See Quotation from Engineering in Coal trade Jnl Mch 79 –

Preeces Lecture before United Service Institute – See Electrician Feby 22/79 – try get original – ground pbly 1st ih –

Latimer Clark – Electrician Mch 15 1879 –

Preeces Mathematical assay on EL Phil Mag Jany 1879 – page 29 =

1 cent 3 mills per 1000 feet
was expense of management
of London Co 1879 —

See Goodwins statement Experiments
Economy Coal VS Gas Cooking
Am Gas Jour - apl 2 1880
in proceedings Gas Assn -

The state inspector gas State Mass
finds upon investigation ~~that~~ that
the average Error of all the meters
about which Complaints were made
was 64/100 of 1 per cent against
the consumer. Get Amn gas light
Jnl March 6 1880. Contain
Hinmans full report

Water gas

gas in press room Quebec Chronicle exploded loss $1000. Feby/80

Chicago Insurance Patrol for 2 months ending Dec 31 found 217 buildings with unsafe gas brackets –

Deaths safein – Sensational account.
Am G L Jnl Nov 16, 1880

Municipality Report Paris Cost
Jablochkoff Light - Engineering
Jany 31 1879

Analysis of the Metropolitan Gas Cos accounts by Mr Field for 1879.

Complete set Amer Gas lighting
" " British
" French

Fontaine's Book -

Haywoods Report on result Lighting Holborn Viaduct,

Also report Costs on Thames Embankment

~~Smiles lives of the Engineers~~

= Brush article in Van Nostrand)

Poors Manual of Railroads -

Life of Stephenson by Saml Smiles.

J Francis, History English Railways ordered to-day

Transactions of the British assn of gas managers full set of [illegible]

Price Glas def cites · 176

A Note on the Sources

The pages which have been filmed are the best copies available. Every technical effort possible has been made to ensure legibility.

39

END

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Centimeter

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1 2 3 4 5

Inches